POPULAR MECHANICS

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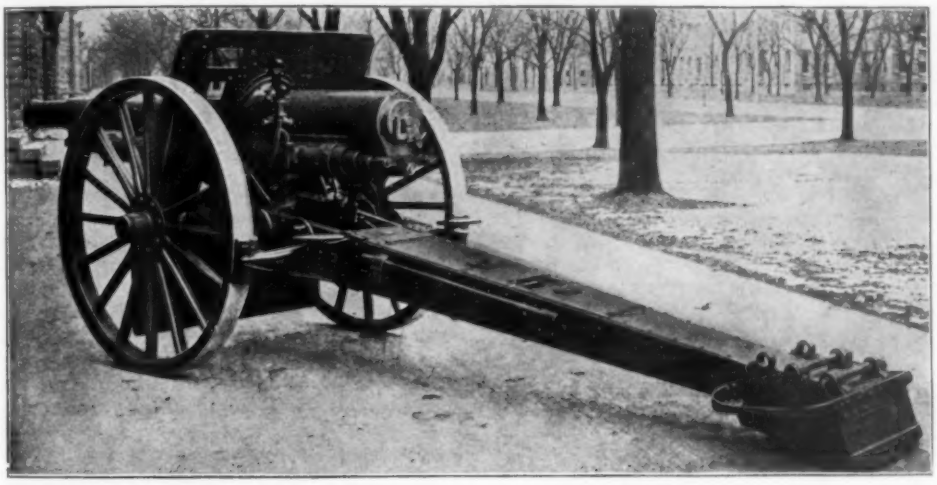
LATEST AMERICAN SIEGE GUN

Shoots Shell and Shrapnel



Carriage Ready for Action

The new siege gun fires a 4.7 in., 60-lb. projectile which with the power and case makes the cartridge weigh 73.75 lb.; the initial velocity is 1,700 ft. per second. The rifle weighs 1,730 lb. and is carried on three tubes, the middle one being a hydraulic cylinder to check the recoil, while the other two contain helical springs to take up the counter recoil. Gun and carriage complete weigh 7,170 lb. High explosive shell and shrapnel are used.

The Journal of the American Artillery Association says: "The ease and rapidity with which the carriage can be unlimbered and made ready for firing, or the reverse, is especially notable. Other prominent features of this material are the great range and power of the gun, great weight of projectile when caliber is considered, rapidity of fire and ease of service resulting from quickly loaded ammunition, improved sights and traversing arrangements, and stability of the carriage."

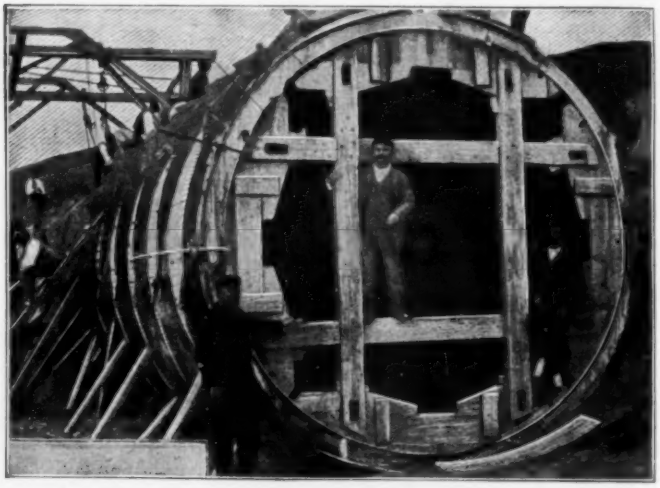
The firing mechanism is of the continuous-pull type in which the firing pin is cocked and fired by a single pull of the lanyard or stroke of the firing lever. The mechanism is simple and consists of few parts, which may be assembled or dismounted without aid of tools. It is rapid, powerful, easily operated, and is provided with safety devices which positively prevent a discharge of the piece before the breech is safely closed.

LARGEST SIPHON IN THE WORLD

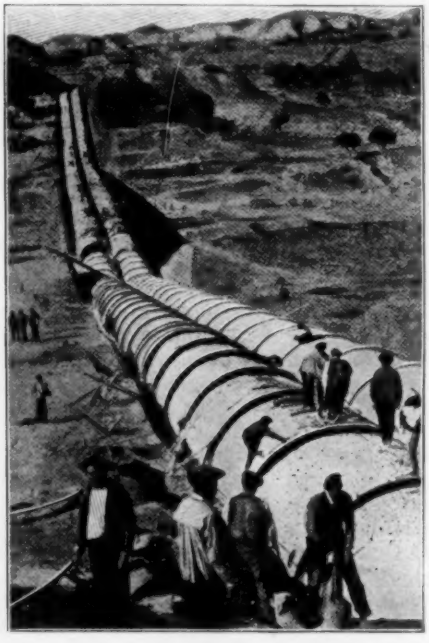
Causes a Small River to Actually Run Uphill

The great irrigating canal across the valleys of Sosa and Ribabona in Spain has just been completed. The system includes a monster siphon 3,500 ft. long which brings the water up over a range of high hills. This was done to save the very much greater expense of tunneling. Many engineers said the plan could not be made to work, but it proved a success when the sluice gates were recently opened by the king.

The canal now furnishes water and makes valuable 247,000 acres of land which for centuries has been barren for lack of water. The canal and ditches offer nothing unusual, but the great siphon is one of the most interesting of engineering feats in many years.



The Tubes Are Built of Concrete



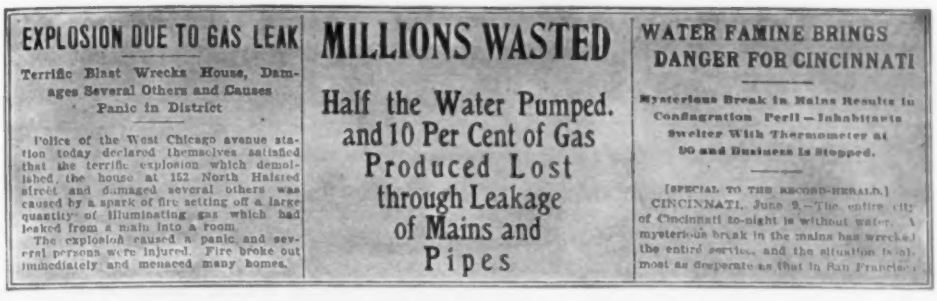
Monster Siphon, 35,000 Feet Long

The siphon consists of two great tubes each 3,500 ft. long and 12 ft. 5 in. in diameter, with a capacity of 7,700 gallons of water per second. The tubes are built of concrete made around wooden forms, and bound at frequent intervals with steel hoops. The inside is lined with steel plate, and the tubes when done were covered with earth for protection and strength.

Two thousand men were engaged for several months in the construction work, and the result is that today the water of a fair sized river is actually running up hill.

BURNS OIL; BREAKS MARINE RECORD

From Singapore via the Cape of Good Hope to Rotterdam, a distance of 11,791 miles, without the loss of a single stroke of her engines, is the record-breaking voyage of the steamer "Goldmouth." This is believed to be the longest trip ever made by a steamer without stopping her engines for even an instant. The ship's fuel supply was oil and on arrival the supply was sufficient for 20 days more.



EXPLOSION DUE TO GAS LEAK

Terrific Blast Wrecks House, Damages Several Others and Causes Panic in District

Police of the West Chicago avenue station today declared themselves satisfied that the terrific explosion which demolished the house at 152 North Halsted street and damaged several others was caused by a spark of fire setting off a large quantity of illuminating gas which had leaked from a main into a room.

The explosion caused a panic and several persons were injured. Fire broke out immediately and menaced many homes.

MILLIONS WASTED

Half the Water Pumped, and 10 Per Cent of Gas Produced Lost through Leakage of Mains and Pipes

WATER FAMINE BRINGS DANGER FOR CINCINNATI

Mysterious Break in Mains Results in Conflagration Peril—Inhabitants Swelter With Thermometer at 90 and Business Is Stopped.

[SPECIAL TO THE RECORD-HERALD.]

CINCINNATI, June 9.—The entire city of Cincinnati to-night is without water. A mysterious break in the mains has wrecked the entire service, and the situation is almost as desperate as that in San Francisco.

VERY FEW PUBLIC WATER WORKS WHICH HAVE BEEN MORE THAN ONE YEAR IN OPERATION DELIVER AT POINTS OF KNOWN USE OR WASTE 50 PER CENT OF THE WATER WHICH ENTERS THEIR MAINS. IN MY JUDGMENT THE AVERAGE LEAKAGE IS FROM 60 TO 66 2-3 PER CENT. IN NEGLECTED SYSTEMS IT IS OFTEN MUCH MORE.—JAMES C. BAYLES, M. E.

Taking the cities of this country as a whole, fully half of all the water pumped by the city water works, and from 10 to 15 per cent of all the gas manufactured, is absolutely wasted. In the case of the gas, the wastage is not only a financial loss, but is dangerous to health and life. The leakage is caused by bad joints and electrolytic holes in the mains and by defective plumbing in buildings. Enough water seeps into the ground, or finds escape into sewers every day to supply the actual necessities of the people twice over. A million dollars' worth of coal is burned every year in this country pumping this waste water.

The water leakage from the mains is probably greatest, and may go on for months and years without being discovered. The water mains of Boston and suburbs, for instance, have 750,000 joints and 150,000 service connections, every one of which may at any moment commence to leak; in fact, from 50,000 to 100,000 gal. daily have been known to flow from a single leak for months without giving any surface indications. Eight leaks were found which totaled 648,000 gal. a day. The total leakage from mains and service pipes in the Boston system alone is from 15,000,000 gal. to 22,500,000 gal. every day. Other cities are even worse.

New York is threatened with a water famine, and yet could the leaks be stopped, the supply now being furnished would suffice for a city three times as large.

In Chicago the waste is astounding. Here there is no shortage in the source as Lake Michigan is of course inexhaustible, but over 400,000,000 gal. are being pumped every day which means more than 200 gal. per day for every man, woman and child in the city. Even with the most extravagant use, it is impossible to utilize over 100 gal. per day per person. The other 200,000,000 gal. goes to waste. As it costs the city nearly $400,000 a year for coal for pumping stations, here is a waste of $200,000 in fuel per annum, and the figures are increasing all the time.

Lest one may infer that the water waste is characteristic of American extravagance, it is well to note that the largest English cities show an average leakage of 60 per cent.

Gas shows a smaller percentage of loss and yet the waste is appalling. In London almost two billion feet of gas escape every year, which at the average price in this country would amount to nearly $2,000,000. This leakage averages 596,187 cu. ft. per mile of mains per year. In this country the loss is about the same and ranges from 10 to 15 per cent, and there are instances where it has reached as high as 60 per cent. As a rule the small mains show the largest proportional loss. Steel pipes screwed together are apt to strip the threads when contraction occurs. One engineer says: "After the contraction I have seen a pipe taken apart by hand which required four men with wrenches at each joint to put together. I have tested lines as perfectly tight at 6 p. m., and at 7 a. m. the following day they were leaking heavily due to shrinkage of the pipe in the trench during the night." As a matter of fact, leaks may and often occur while the trench is being filled, in a pipe line which tested all right when the order to fill was given.

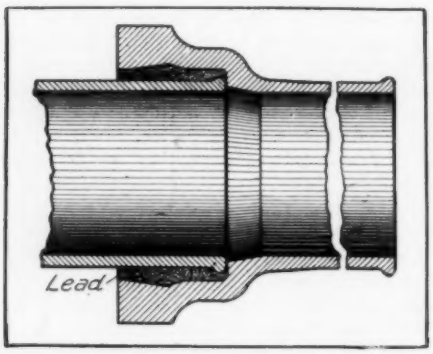
Eighty per cent of leaks in mains are due to joints opening under expansion and contraction. Other common causes are from unequal settlement, oxidation and electrolysis, and from jar and vibration.

Bad Case of Electrolysis in Water Main

There are 1,000,000 lead caulked joints in the gas mains of Chicago.

Pipes underground seem imbued with life; they are never inactive, something is doing every moment. Mr. Bayles says: "Expansion and contraction are constant. Pipes in the ground are never at rest, but lengthen and shorten with each variation of temperature. This movement is slight, rarely exceeding two inches in a thousand feet through the range of a year, but it is irresistible. If not accommodated, it will accommodate itself. The forces acting upon a pipe are so much stronger than any iron ever made that the rigid pipe is inevitably broken."

From this, the reader will better understand the frequent explosions which attend underground work in cities. The gas enters the chamber where men are at work, and an accidental spark, as when a pick strikes a stone, explodes it, generally with fatal results. Manhole covers in streets that are shot into the air owe their activity to gas escaped underground.



Bell and Spigot Joint

Cast-iron pipes have a longer life than steel. There was recently taken from the River Seine in Paris a cast-iron pipe line which was laid in 1802. It was in good condition, and the maker's name and date cast on each section was easily read. In Rheims cast-iron pipes laid in 1748 were taken up in 1840 in good condition.

The method of joining cast-iron pipes has been the bell and spigot joint in which the straight end of one section was extended a few inches into the bell-shaped end of the next. The joint was then made tight by pouring melted lead to fill the bell and hammering the lead into the joint on the same principle as a dentist hammers a filling into a tooth. It will readily be seen how slight a disturbance of either pipe section will loosen the joint and cause a leak.

The amount of leakage depends upon the pressure in a pipe. A round hole ¼-in. in diameter will leak 12,960 gal. in 24 hours with 45 lb. pressure; the same hole will pass 14,431 gal. with 60 lb.; and 18,600 gal. under 90 lb. pressure.

Pipe lines for all purposes are now being laid with a patent pipe made in 6-ft. lengths and joined iron to iron without the use of lead or other packing. The pipe is cast of softer iron with a much higher tensile strength, the ends being machined and held together with heavy bolts passing through lugs cast in the pipe. The illustration shows how this is done. The connection being a perfect metal joint is a better conductor of electricity, and danger from electrolysis is consequently lessened.

New Anti-Leak Joint

HOW TO SMOOTH A GUN BARREL

Cut a dove-tailed slot in one side of a stout hardwood stick which is somewhat longer than the barrel of the gun and of a size to slide into it easily. Insert a half round file in the slot and then scrape or grind the barrel as much as necessary. To keep up the proper pressure, put strips of thin cardboard between the file and the stick. To get a perfectly smooth finish after filing, says the American Blacksmith, use emery flour.

MACHINE CAUSES DEAD TO BREATHE

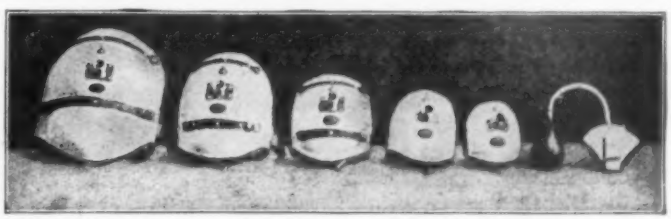
Remarkable Apparatus of Hungarian Surgeon for Reviving Drowned or Asphyxiated Persons

Dr. R. Eisenmenger, an eminent surgeon of Szarvos, Hungary, has invented a machine for producing artificial respiration. So simple and effective is its operation, the wonder is it was not thought of long ago. Periods of alternate compression of air and vacuum cause patients who have ceased to breathe to do so with all the natural motions of a live person.

In the case of persons who are taken unconscious from the water or suffering from asphyxiation as a result of inhaling deadly gases, or who have ceased breathing from electric shock—in all these cases life is frequently saved after one to four hours of artificial respiration.

While the process of working the arms up and down to fill the lungs with air, and discharge it again, is by no means difficult, yet comparatively few people know how to do it successfully. There is a knack in the movement which comes only from actual practice, and the regularity of the movements has largely to do with results. The average inexperienced operator works too rapidly and irregularly, due to excitement. Efforts should not be relaxed for three or four hours, as the life spark may still be there, although to all appearances the patient is dead.

The Breathing Machine Operating on a Child--Below Are Shown a Series of Shells Ranging from Adult Size Down to Infant Size



The apparatus devised by the surgeon consists of a metal shell, in shape not unlike that of a turtle shell. These shells are made in sizes ranging from use for infants up to adults. To the under side of the shell is

fastened a soft, flexible rubber bag, which is in contact with the skin when the apparatus is strapped tightly over the chest and abdomen. From the bag through the top of the shell a flexible tube leads to a bellows placed on the floor and operated with one foot.

As the bellows is pressed down the air it contains is forced through the tube into the rubber bag under the shell, which expands against the patient, pressing the abdomen, which in turn presses the lungs and forces out through the nose or mouth the contents of the lungs, either water, gas or air. When the foot pressure in the bellows is removed springs cause the bellows to open, drawing back the air which fills the rubber bag, and, on account of the shell fitting tightly to the body, creates a vacuum, which draws the abdomen up into the shell, causing the lungs to fill with air in the usual way.

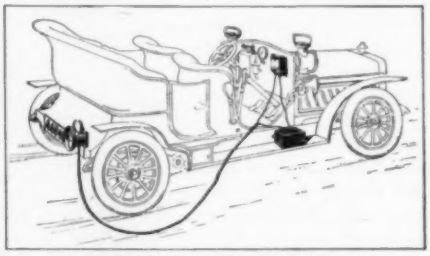
The action of the bellows and the corresponding inflation and deflation of the lungs can be maintained by great precision and with little exertion by the operator, who can increase or decrease the rate of respiration, as desired. This method of artificial compression and expansion of the abdomen perfectly imitates the natural movement of the involuntary muscles which produce normal breathing, only in this instance the propelling power comes from without instead of within the body. The invention is reported to give surprisingly good results and already to have saved several lives.

SCARLESS SURGERY

When skin is cut on the bias the wound can be closed up without leaving a scar. Surgeons have discovered the fact to the profit of mankind. The edges of the skin are adjusted by means of a magnifying glass, after the operation, and are held in place by means of a dressing of glass and wool.

REAR LIGHT TELL-TALE

English users of motor cars are adopting a new device which instantly reports the failure of either of the rear signal lamps. The penalties in that country for running without the full complement of lights are heavy. The device is for use in connection

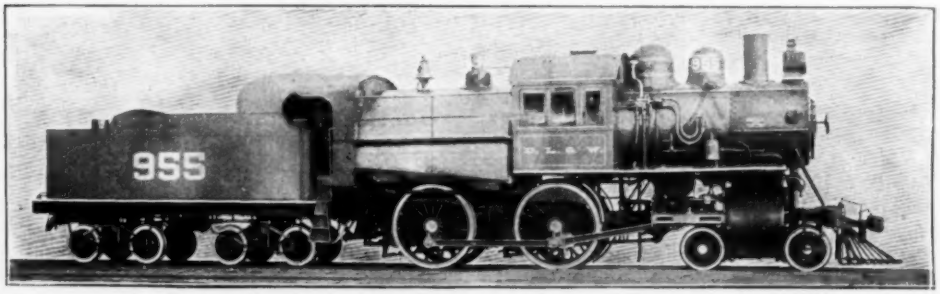


Tells When Light Goes Out

with electric lamps, and the instant a lamp fails the fact is announced by the ringing of an electric bell. For the purpose of illustrating the apparatus, the connecting wire is shown exposed in the cut. In use the wire is concealed.

CULM BURNING LOCOMOTIVE

The illustration shows the latest type of passenger locomotive built by the American Locomotive Co. for the Lackawanna. In order to burn hard coal culm the firebox is made large, being 109 in. wide by 126 in. long, with a heating surface of 190 sq. ft. The engine and tender weigh 261,200 lb.. The tender carries 5,000 gal. water and 10 tons of coal. On account of the large firebox the engineer's cab is set forward.



Engine That Burns Poor Coal Without Smoke

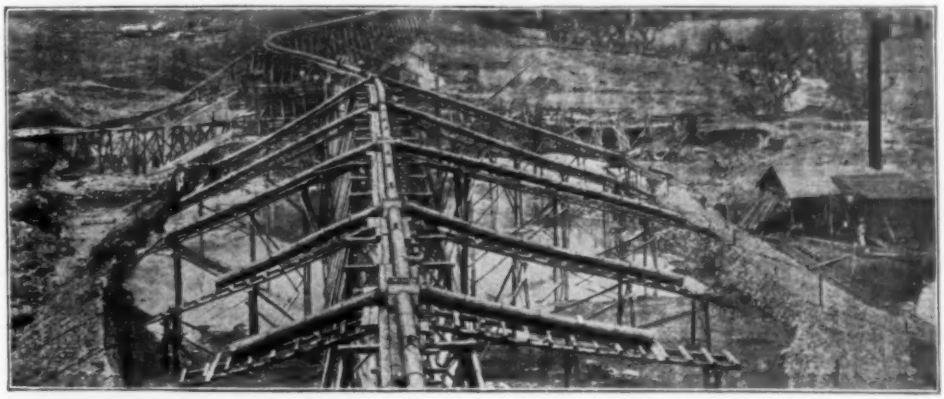
LONGEST TRANSMISSION LINE IN THE WORLD

Furnishing Mexico City and Suburbs with 200,000 Horsepower--Waterfall of 2,000 Feet --Electric Current, 60,000 Volts

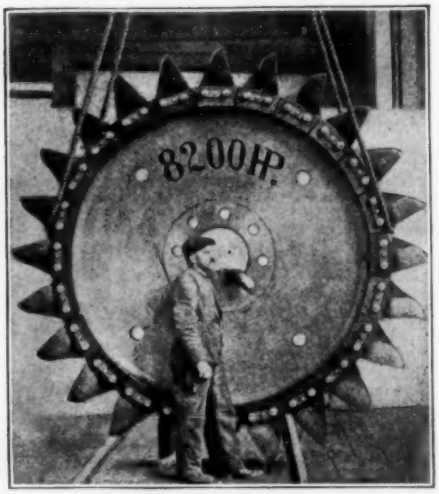
On the last day of last year the waters of the Necaxa river, Mexico, plunged over its upper and lower falls nearly 2,000 ft. into the valley below. On the first day of this year the falls had disappeared, and the people in the valley marveled at the strange silence which oppressed them, and gazed in wonder at the mist which floated down where yesterday a great river had thundered.

A world beauty had been captured; snatched from its bed of ages; forced to flow through dark mountain tunnels and immense steel pipes; and thus bound, to earn its liberty by turning great wheels in an underground dungeon, and when finally released, to emerge in a placid mill pond, robbed of its former power and grace. One hundred and eighty-one miles away in a big mill, the former thunder of the falls is heard, as night and day scores of stamp mills pound ceaselessly upon thousands of tons of rock rich with the golden metal. Beauty has been converted into power, and the power is in turn transformed into dollars. To accomplish this has taken $18,000,000 of money, and the labor of 6,000 men for three years.

Ten years ago a progressive Frenchman, Dr. Vaquie, of Mexico City, conceived the idea of a waterpower for manufacturing industries to be located at the falls. The place was inaccessible, and after a few years he transferred his rights to a light and power company, organized in 1902 to generate and transmit electric current. A good joke is told on the doctor, who, thinking to get a higher price for his concession, bargained for its sale on the basis of the volume of water passing over the falls during a given period. This arrangement was agreed to, and for two weeks experts measured the flow each day. The period chosen by the doctor was usually one of great abundance of water, but this time turned out to be the driest season in many years, so the power company bought the rights for about half their original offer, which had been refused. Already 20,000 hp. is being produced, but when the plans are carried out the output will be 200,000 hp. and is to make possible the vast manufacturing enterprises which are now planned for the capital city. Already the city water works, all the electric cars and all the electric light of Mexico City are furnished by power from the falls. The city, with 1,500 arc lights along its streets, is said, based on population, to be the best lighted city in the world, while the cost to consumers has been cut in half for both light and power, and is the lowest of any large city today. A horsepower costs



BUILDING A DAM—The dams were built by first constructing the "toes" of stone masonry and cement, and then filling in the space between until the required height was reached. The filling is sand, gravel and small stones brought down by means of water, through pipes, from the mountains. The illustration shows the main pipe extending back to the foothills, and the distributing laterals for discharging on the dam, supported on wooden frames which are eventually buried with the filling.



8,200 HP. TURBINE—There are already six of these powerful water engines; seventeen more will be installed soon, producing over 200,000 hp.

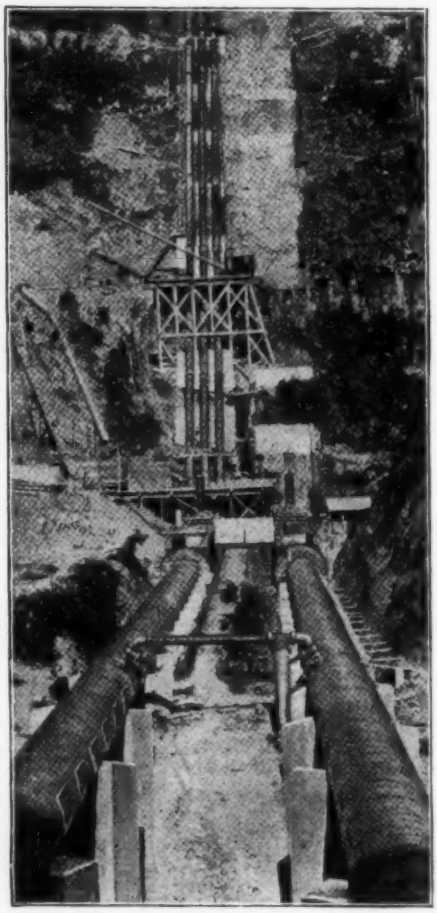
$50 per year for continuous use; a reduction of 65 per cent over former cost.

Mexico has now the longest electrical transmission line in the world, and engineers everywhere are studying this latest and most modern of all large installations. From the falls to Mexico City is 95 miles, but the line is continued on to the great mining plants at El Ora, 86 miles further, making a total of 181 miles. The transmitting cables weigh 4,200 tons, and are carried on tall steel towers instead of poles. There are over 3,000 of these towers, and 36 watchmen constantly patrol the entire line night and day. The line cost $10,000 per mile. Notwithstanding the enormous voltage—60,000 volts—at which current is transmitted, a telephone line is in operation 9 ft. above the feeder wires, but the extreme danger of its use has led to experiments with wireless and in a few weeks the wireless system will be used exclusively.

The loss in transmission, transforming and leakages of all kinds over the entire system is only 20 per cent, and it is expected this will soon be reduced to 12 per cent. The present loss between the generating station and the city, 95 miles, is only 6 per cent; and from the city to El Ora, 86 miles, is 8 per cent. At El Ora all the work of hoisting, stamping, drilling, etc., amounting to 10,000 hp., is being done with transmitted power, and new machinery now going in will raise the power consumption to 18,000 hp. The saving here over coal, formerly used, is a reduction from $200 to $50 per horsepower per year.

The power house contains six sets of generating machinery, with an output of 40,000 hp. This will be increased as fast as needed until the station is producing 200,000 hp. The present effective head of water is 1,413 ft., which gives a pressure at the lower gates of 595 lb. per square inch. When the auxiliary station is completed it will have the enormous head of 2,100 ft. and a lower gate pressure of 900 lb. per square inch.

In its passage from the river above the falls, to the power station, the water flows through canals; 4½ miles of mountain tunnels; 5½ miles of 6-ft. and 8-ft. pipes; and 7 miles of 30-in. steel piping, which is .95 in. thick at the lower sections.



PIPE LINES—Section of the great steel tubes in which the water is conducted down the mountain to the power house.

The watershed drained by the Necaxa has an annual rainfall of 135 in., and to conserve this great body of water four dams are being built, ranging from 66 ft. to 177 ft. in height, with a total length of over one mile. These will form vast lakes, containing five billion cubic feet of water, affording a reserve supply of 50 per cent more than required.

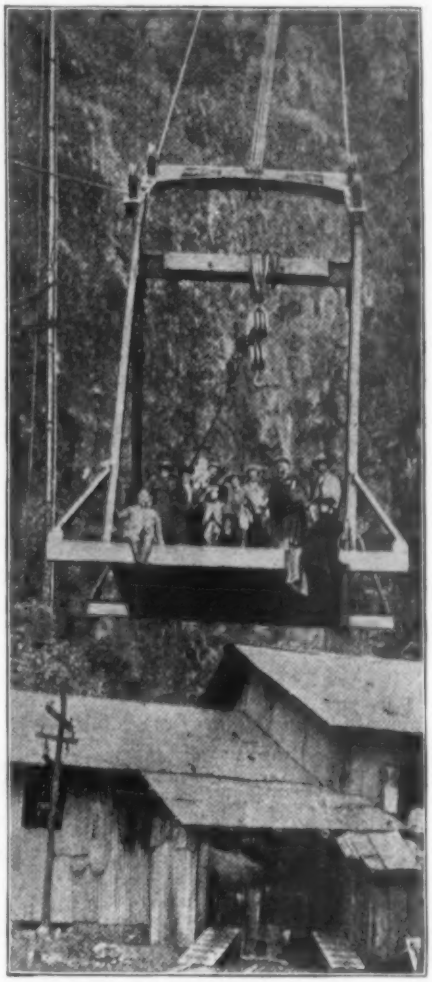
In the construction of the work 27 miles of railroad were built, and an aerial elevator capable of hoisting 15 tons at one load. This elevator travels on steel cables reaching from the valley to the crest of the upper falls, and has a drop of 1,200 ft.

The turbines, which were made in Switzerland, are 100 in. in diameter and carry 24 cast steel buckets. Modern Mexico says:

"The water is directed against the buckets from two nozzles, set diametrically opposite each other, an advantage of the vertically set wheel over the horizontal system usually employed in that the force is continuous, and the water from each of the two streams cannot interfere with that from the other, giving a vast power and an evenly balanced wheel, allowing a smaller wheel, higher speed and lighter bearings. The two nozzles, which have rectangular openings, are 4½ in. square when opened full, and are automatically regulated by oil governors, so joined that the openings of the valves of the nozzles are always equal in size. A safety valve allows for the escape of the water if the pressure gets beyond the control and the wheel moves too fast.

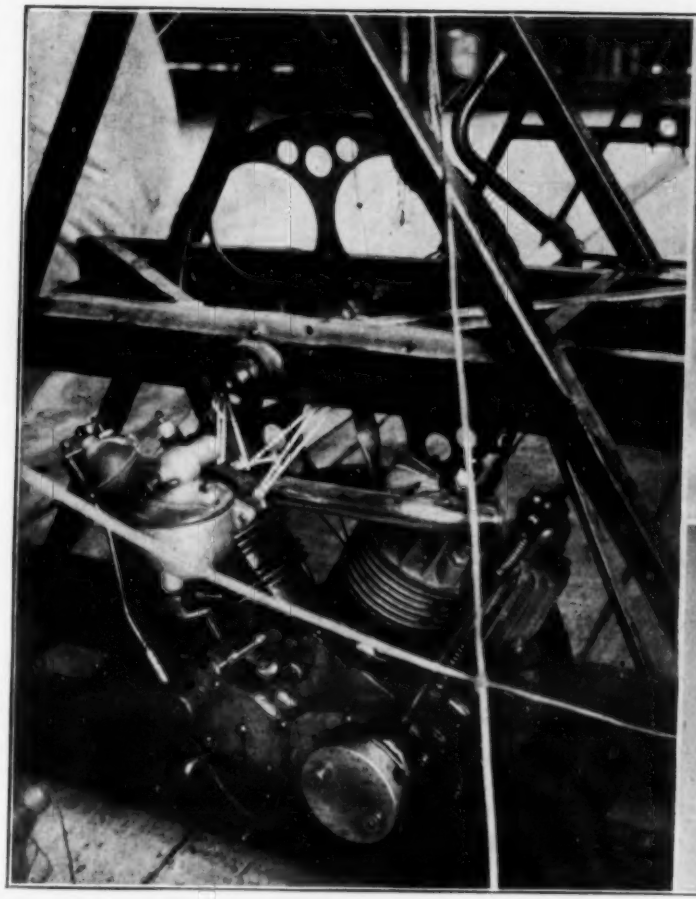
"The present overhead line of nearly two hundred miles is the longest ever attempted from a single power house. In California there are lines aggregating 243 miles about San Francisco, but this measurement is obtained by taking the entire circuit of lines, into which several power houses feed at various points along the line. The greatest distance to which the power from the various Niagara Falls plants is transmitted is 60 miles, to Toronto, Canada. The current generated in Necaxa is three-phase, and when raised to the high potential of 60,000 volts, is taken out in four circuits, three wires to each circuit. For handling the current conductors consisting of six-strand copper cables with hemp cores are used. The copper cables are half an inch in diameter, and have a strength of 60,000 lb., and an elastic limit of 40,000 lb. per square inch. The cables are shipped in lengths of 5,000 ft., and joints are made with 18-in. copper sleeves. Cables will stand a wind velocity of 100 miles per hour."

A great stimulus to manufacturing will immediately occur on account of the cheapness of the power, which will be sufficient to supply 400 industries with 500 hp. each; at the same time the absence of smoke and gases from burning coal will make Mexico City the smokeless city. A total investment of $31,000,000 will be made by the power company in carrying out its plans.

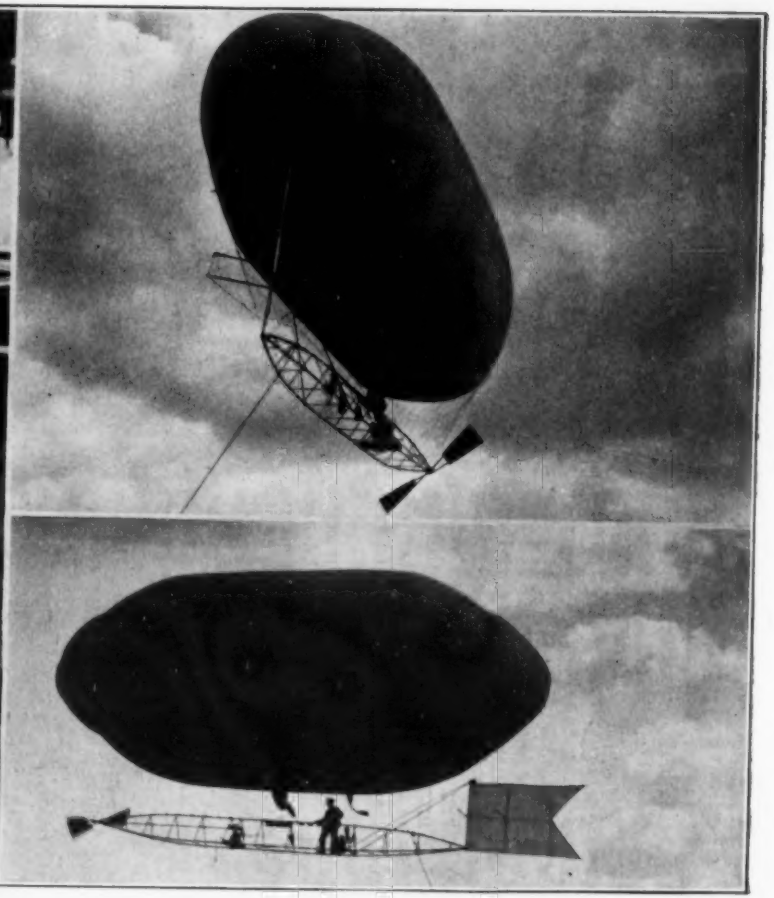


CABLEWAY ELEVATOR—This elevator is hung by trolleys from two steel cables, stretching from the valley 1,200 ft. up the mountain. It was used for hoisting materials which could be taken up in no other way. Fifteen tons are elevated at one load.

A Philadelphia man who was stabbed in a fight had his heart removed, sewed up with six stitches and replaced in his body. He has a good chance of recovery, for all that his heart was in the surgeon's hands 20 minutes.



The Airship Motor



Views of the Flight

AIRSHIP CIRCLES WASHINGTON MONUMENT

Sails Around the Dome of the Capitol and Makes a Call at the White House--Flight Covers 20 Miles

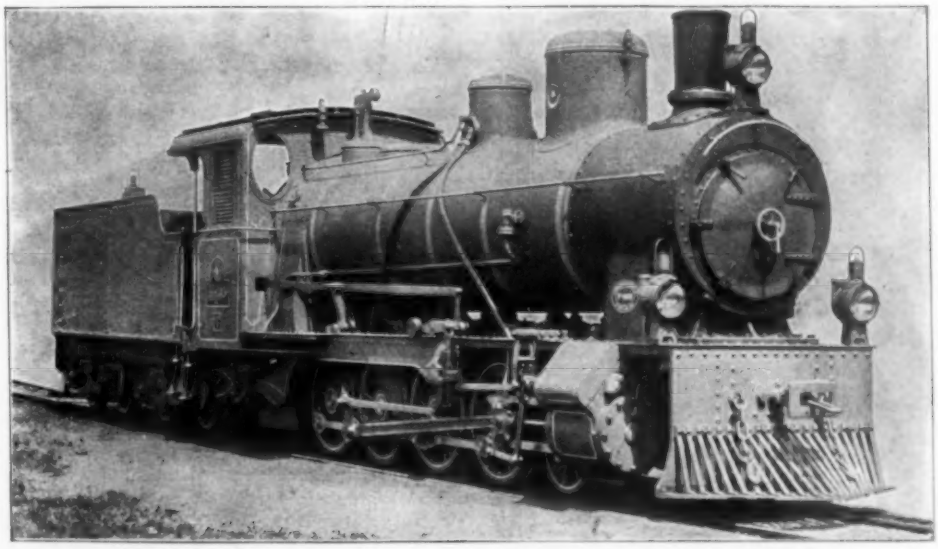
Stately senators and eloquent congressmen are no more immune to the sensation of a real airship overhead than the average small boy at a county fair. Business at the Capitol was suspended for a full half-hour, while the entire city gazed skyward. There was good reason for it all, too, for a young American from California was demonstrating in a way never accomplished by even Santos Dumont. An airship sailing around the great dome of the Capitol, like some mammoth bird, and later circling around the Washington monument in a graceful ascending spiral, was something never before witnessed.

From the monument the ship sailed straight for the White House and gently came to rest on the lawn, where the President's wife, in his absence, acknowledged this, the most novel call ever made at the executive mansion.

The captain of the airship is a young Californian—Lincoln Beachy—who is a mere youth. He became interested in the work while helping a balloon man in San Francisco a few months ago. His ship is 66 ft. long, 16 ft. in diameter, with a two-bladed propeller in front and a large rudder. The flight described was of nearly 20 miles. The construction of the gas engine will readily be understood from the illustration.

A German lad has invented a device for controlling and changing the direction of a torpedo after it has been fired. His machine is being tested by German naval officials.

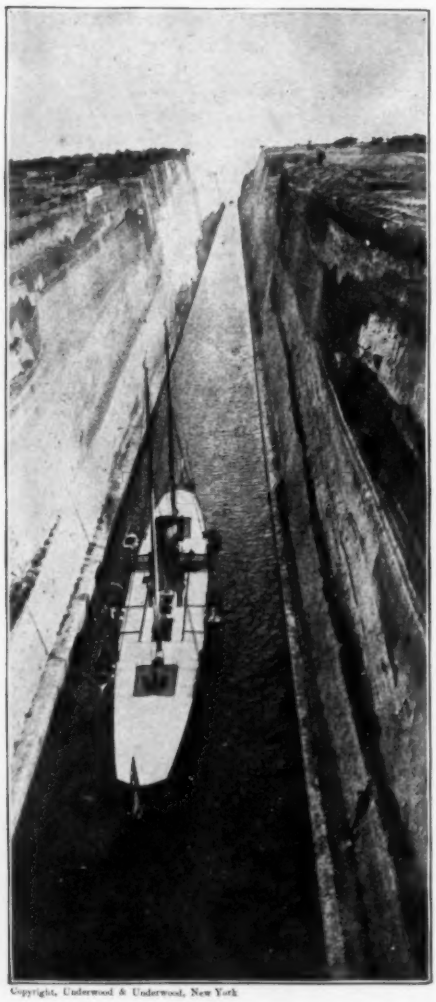
NOTABLE FOREIGN LOCOMOTIVES--No. 6



PALESTINE—THIS CONSOLIDATION LOCOMOTIVE IS ONE OF SEVERAL OF THE SAME TYPE IN USE ON THE DAMASCUS & MECCA RAILWAY, PALESTINE. THIS ENGINE IS NOW HAULING TRAINS IN THE LAND OF CANAAN "BEYOND JORDAN." THE GAUGE OF THE RAILWAY IS 3 FT. 5¼ IN. THE ENGINE WEIGHS 45 TONS AND THE TENDER 40 TONS.

PANAMA CANAL TO BE LOCK TYPE

The Panama Canal will be of the lock type, and with $25,000,000 in hand for actual work the digging will now commence in earnest. Time and expense were the reasons for the decision. The sea level canal would have cost $400,000,000 and required 20 years to build, whereas the lock canal can be in use in 10 years and is estimated to cost only $140,000,000, while the operating expense of the lock type will be $2,000,000 less per year than the other. The locks can be removed at some future time when the income and necessities warrant the expenditure. The decision is the result of the recommedation of the President, who will visit the Isthmus next fall and make a personal study of the situation instead of relying on reports of engineers and others. In view of the great importance of the enterprise and the amount of money involved, this trip of the chief executive will meet with general approval as a businesslike thing to do.



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A Sea Level Canal

CANAL CUT THROUGH SOLID ROCK

The Corinthian canal which connects the waters of the Gulf of Corinth, Greece, with those of the Gulf of Egina is one of the most remarkable in existence. It is a sea level canal, only four miles long, but it is a channel cut straight through the solid rock, the massive walls towering on either side to a height of 260 ft.

The canal was built in 1882-1893 and enables vessels to sail from the Archipelago to the Adriatic without rounding Cape Matapan. The ancients saw the advantages in a canal through the isthmus and several unsuccessful attempts at constructing one were made, first by Periander, tyrant of Corinth, in 600 B. C.; later Julius Cæsar and Caligula revived the scheme, and still later the Emperor Nero re-embarked the project with more promise, but on his death it was abandoned.

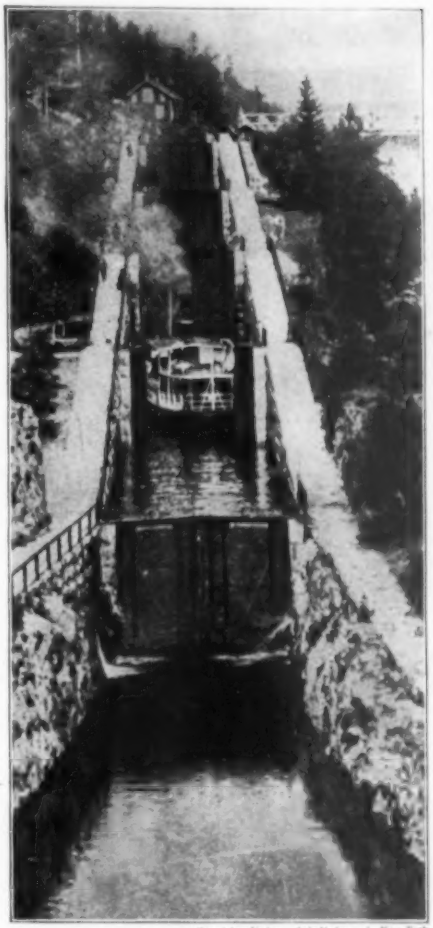
The canal cost $11,000,000. The rush of wind through its rock-walled channel is at times terrific and vessels passing through are obliged to tie up till the storm subsides. Iron stanchions to which the ships may fasten are placed at 600-ft. intervals and the canal is lighted by electricity at night. Our illustration shows J. Pierpont Morgan's steam yacht "Corsair" passing through the canal.

RAILWAY PHOTOGRAPH CARS

Two cars have been fitted up with all the requirements for taking, developing and finishing large and small photographs and will be used by the Southern Pacific. A corps of expert photographers will be employed in taking thousands of views of scenery and cities along the company's lines from Portland to New Orleans and Sacramento to Omaha.

HOW A STEAMBOAT CLIMBS A HILL

Even a steamboat can climb a hill by going up one step at a time. This remarkable performance can be witnessed several times daily during the season of navigation beside the Vrang waterfall in the Bandak Nordsjö Canal, Norway. At this point falls in the river prevent the passage of boats up or down, and a canal has been built around the rapids and falls. The ascent is made through a series of locks which accommodate one boat at a time, and in passing from the lower to the upper lock the boat is lifted about 90 ft. The illustration shows a boat entering the second lock on its way up the hill. In this instance the locks are small, as none but small boats are in service and the locks are continuous. The picture, however, gives an excellent idea of the lock system. In the case of the Panama Canal the locks will have to be the largest ever built and will be located at intervals over the entire route, according to the topography of the country.



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A Lock Canal--Five Locks Connected in Series--Unusual Construction.

HIGHWAY ENGINEERING AN INVITING FIELD

Highway engineering offers a promising field, both in honors and money, to the ambitious young man. Not only are the people of this country waking up to the value of a good road but they are beginning to appreciate the fact that while anybody can scrape a little dirt into the middle of the road, that, as in other things, it is cheaper in the long run to have experience and brains as well as teams and scrapers.

When some one feature of a general line becomes important the condition is recognized by being specialized. The practice of law has thus naturally divided into many branches, and a man who has a patent to secure or defend does not apply to a noted criminal lawyer to prosecute his case. A heart specialist is not called to perform a difficult surgical operation. Hence, the time has come when the services of a specialist in highway engineering are called for rather than those of some other engineering specialist whose work is hydraulics, ventilation, lighting or tunneling. Indeed the demand for highway specialists has reached the point where a well known college of engineering and mechanics has made highway engineering a special course extending over four years of study. Having completed this course, the young engineer starts out in life better qualified and possessed of more experience than he would secure in the ordinary course of events in a whole lifetime.

ALCOHOL FROM WASTE SAWDUST

In anticipation of the large demand for alcohol for light, heat and power, preparations are being made for the erection of plants through the South to work up the mountains of sawdust made at the sawmills. The first plant, using a new mechanical process and costing $250,000, is nearly completed at Hattiesburg, Miss.

CONSTRUCTION OF INFERNAL MACHINES

Chemical and Mechanical Skill of High Order Employed in Making Bombs

Bomb Exploding in Attempt on the King of Spain

The recent attempt on the life of the King and Queen of Spain, under conditions which outraged the entire civilized world, calls attention to the high order of chemical and mechanical skill engaged in the invention and construction of infernal machines and bombs. The clumsy gas pipe bomb of 20 years ago, which was not only difficult to conceal but more dangerous to the possessor than to the intended victim, has been replaced by apparatus of a high mechanical order and whose operation can be adjusted to a nicety.

That the recent attempt at assassination failed was through no fault of the mechanism of the bomb, which exploded exactly as planned as to time, and the point at which it burst was as accurate as possible with a missile thrown from a fifth-story window.

Illustrations of some of the infernal machines and bombs which have been captured during the past few years by the secret service of the Paris police show the internal construction and external finish of these fearful engines of death to be of a high order of workmanship.

Fig. 1--Bomb in Bouquet Same as Used Recently at Madrid

Fig. 1 shows a small bomb capable of being carried in a bouquet and is similar to

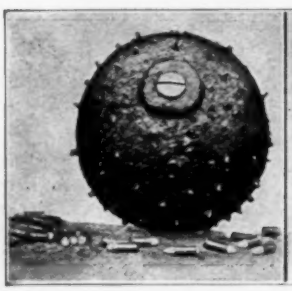


Fig. 2

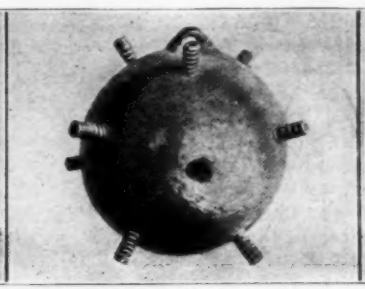


Fig. 3

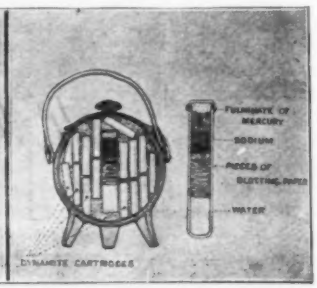


Fig. 4

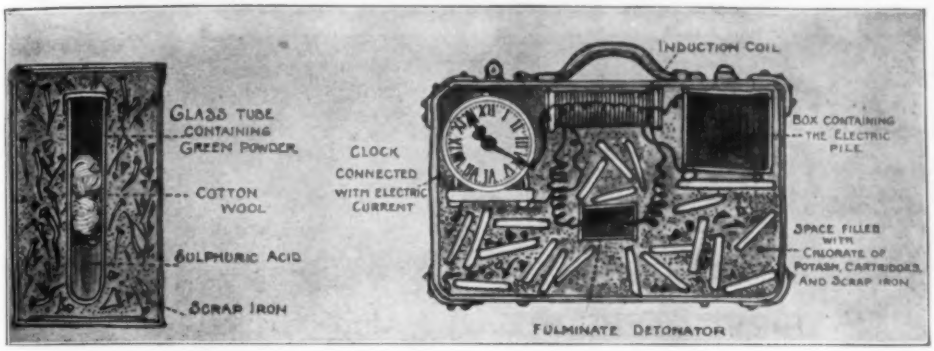


Fig. 5 **Chemical and Electric Infernal Machines** **Fig. 6**

the one used in Madrid. The spikes, which extend in all directions, make it impossible for the bomb to strike any hard substance without one or more of the spikes receiving the blow which explodes the cap and in turn the explosive contents. Fig. 2 shows a bomb which was made for use at the explosion of the Orient club at Constantinople. It contained a large number of dynamite bullet cartridges in addition to the bulk explosive. In Fig. 3 is seen one of Orsini's bombs, showing the detonating studs. In Fig. 4 is a chemical detonator in which water is the prime factor of action. This bomb must be carried in an exact position and will explode at the expiration of a prearranged period of time, which is determined by the amount of blotting paper. This paper gradually takes up the water in the bottom of a tube until the moisture rises to a layer of sodium, which is thus ignited and fires the fulminate of mercury, which in turn explodes the dynamite with which the bomb is filled. This machine requires very careful manipulation and to be kept in an upright position, or it will explode prematurely.

Fig. 5 is also a chemical bomb, containing sulphuric acid, which ignites the charge and scatters sharp nails and bits of rusty iron.

Fig. 6 is an infernal machine which is more complicated than the others, but safer to handle, and which can be made to explode hours after it has been placed. The dial on a clock enables the operator to time the explosion to a minute.

Chemical bombs have been recovered in Russia which are fired by the action of water on sodium.

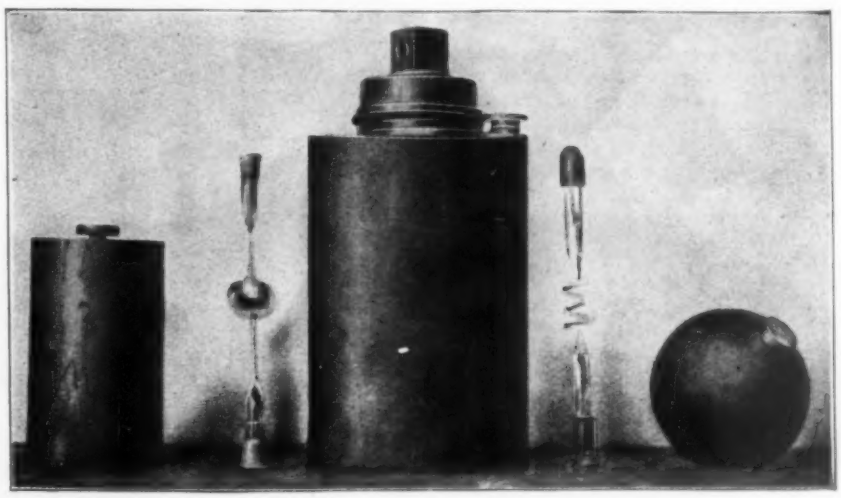
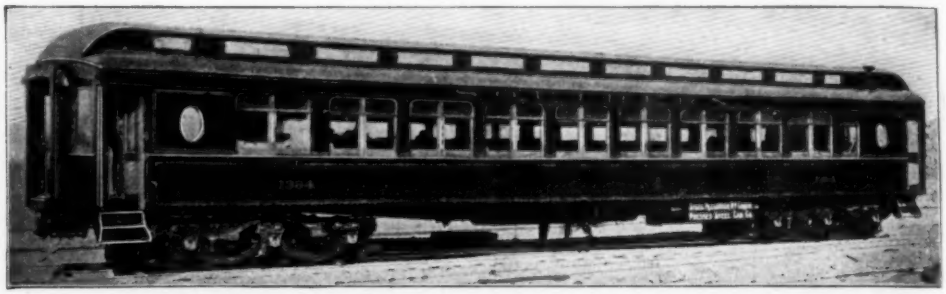


Fig. 7--Russian Chemical Bombs



FIRST STEEL STEAM PASSENGER CAR

Passenger cars built of steel have been in use some time on street car lines, elevated roads and subways, but only within a few weeks past has there been an all-steel passenger car for steam roads. This car, which in appearance closely resembles a car of wood construction, is 74 ft. long and painted to resemble wood. It was built in Pittsburg for the Southern railway and is doubtless the beginning of a change which in not many years will remove from service all passenger cars constructed of wood.

LARGEST FREIGHT STEAMER IN THE WORLD

The largest freight steamer in the world now floats on Lake Michigan, having recently been launched at Chicago. The hull is steel, 600 ft. long and 58 ft. wide. If set up on end it would extend 45 ft. above the Washington monument. The forward deck rises 30 ft. above the water. The vessel, which is named the "J. Pierpont Morgan," has engines of 3,600 hp., weighs 4,800 tons and will travel 11½ miles per hour, loaded, on a coal consumption of 3,000 lb. per hour.

LIFE-SAVING BRIDGE NET

Near Monte Carlo is a narrow bridge crossing a deep chasm, and on account of a sudden turn in the road, at the foot of a steep hill, several fatal accidents have occurred. To prevent cyclists and automotorists from plunging over the low stone guard, a wire net supported by a strong steel frame has been erected by the Touring Club of France, and has already saved the lives of a number of over-daring and careless riders.

Wire Net for Catching Bicyclists

HOUSE AUTO FOR ADVERTISING

An energetic concern manufacturing roofing for houses has adopted a unique advertising scheme. A small one-story house is built on a motor car, the house being constructed of the roofing and other materials manufactured by the firm. At the top is a good-sized sign. The house-cars are sent out through the country distributing samples and getting people interested in the goods.

Traveling Roof Exhibit

LIFE-SAVING HELMETS

Enables Repairing in Clouds of Deadly Fumes from Chemicals

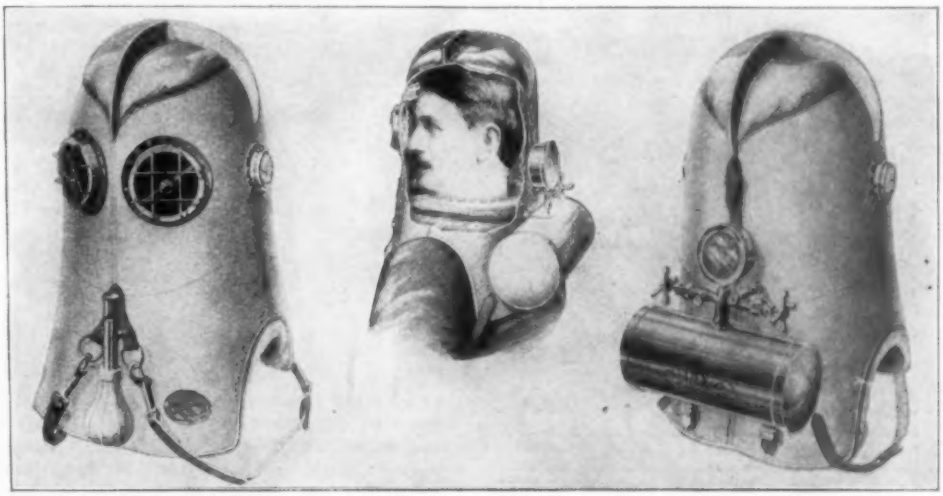
When an ammonia pipe bursts in an ice factory or cold storage plant, the fact is known instantly. Not only the startling explosion warns the workmen, but the clouds of deadly, poisonous fumes which instantly fill the place drive every living thing which can do so to make its escape. The principle of the submarine diver's outfit has been used in providing a workmen's helmet which enables a man to enter a room and work for an entire hour where he could not otherwise live two minutes.

When an ammonia pipe bursts the first thing is to get to the nearest cut-off valve and shut off the flow. This can seldom be done for the reason that at the first whiff of the deadly gases the man falls senseless and in a few moments dies. Such accidents are frequently reported in the daily papers, especially during the summer when the ice plants are being run to their utmost capacity.

The life-saving device which enables the wearer to walk fearlessly into danger consists of a tight fitting helmet which rests upon the shoulders and is held securely by straps passing under the arms. A tank on the back of the helmet contains a supply of air to last one hour, the air being fed into the helmet immediately under the nose, and its flow regulated by a valve. A gauge always shows the exact amount of the supply.

Opposite each ear is an ear piece which has a sounding diaphragm which transmits sounds like a telephone receiver. The operator can hear but not talk. He can give signals, however, for in front of the mouth is a tube leading to a whistle which hangs in front of the helmet, by means of which he can give prearranged signals or call for help.

The two lookouts for the eyes are ingenious, being made of mica, of double thickness. As moisture from the breath at intervals clouds the vision, a cleaner which passes over the inside of the lookouts is turned by the wearer, by means of small thumbscrews on the outside. The hands and other portions of the body not covered by the helmet are exposed. In this respect as well as being able to move freely and at will anywhere, the operator has a decided advantage over the diver, who is heavily loaded and who must constantly guard his air pipe and never strain it by going beyond its length. In the head protector the waste air finds an outlet along the edges of the helmet next the shoulders, instead of through a valve. The protector can be put on and made ready for use in a few seconds. The air tank is always kept filled ready for any emergency. In addition to use in ice plants, the helmet can be used in mines, or buildings filled with smoke, and several navies include them in their equipment.



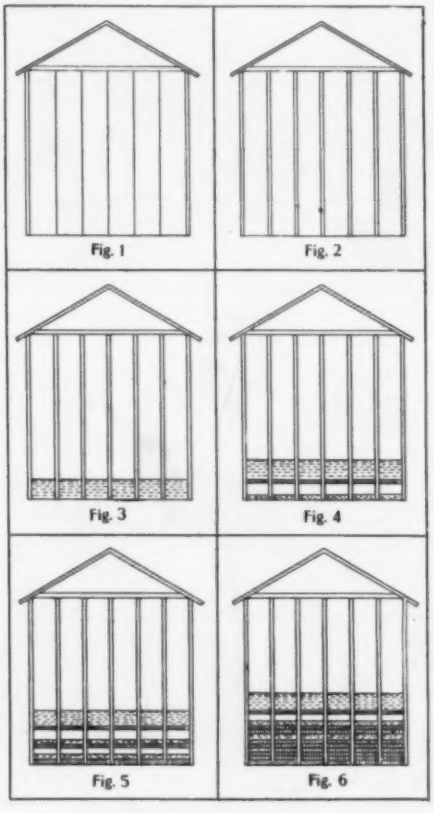
Front Side View Rear

A MECHANICAL ICE HOUSE

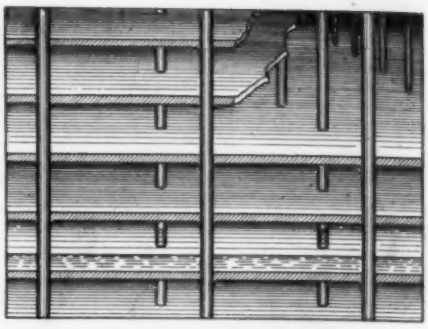
In Which One Solid Cake Fills the Building--Freezing by Natural Cold

The most remarkable ice house event was the freezing in the house itself of a single solid cake of ice the full size of the building. The only tools employed were some pieces of string and a garden hose. Cold weather and a water supply with at least moderate pressure are also essential, but all out-door cutting, hauling, and storing are avoided, and, as no sawdust is used, the ice comes out clear and clean.

Owing to the mild weather of the past winter, there is a great scarcity of ice this season. Many small lakes and rivers, which have always been depended on to give a good supply, failed to freeze more than a few inches, and it will be impossible to furnish this deficiency by means of artificial ice plants, even though all the refrigerating machines in the land were worked to their full capacity.



Stages of Formation



Building Ice Strata

Some three years ago a mechanical ice house was patented, in which the water was frozen inside the ice house by a very rapid process, which will be described later. In this process the labor of cutting and hauling is obviated without the use of powerful or expensive machinery. That this process has never been carried further than the experimental stage is probably owing to the fact that the winter following its invention was the severest in 40 years, Lake Michigan being frozen from shore to shore at that time. The experiment, so far as conducted, seems to have been successful, a large barn being filled with practically one solid cake of ice.

The process of freezing ice in this way is as follows: A large ice house is built with two of the opposite walls hinged, allowing them to be opened by folding up during cold weather, and closed during milder weather, thus preventing the ice from melting. To begin operations a number of strings are suspended from the rafters at distances of two or three feet apart. The strings hang down and touch the floor, as shown in Fig. 1, and the first cold night they are sprayed with water, which forms large icicles reaching from the floor to the top, as shown in Fig. 2. A quantity of water is then flowed into the ice house, as shown in Fig. 3, and allowed to freeze.

When the ice is one inch thick the water is pumped from underneath it and flowed on top, leaving only one inch remaining below, as shown in Fig. 4. When the upper layer of water has frozen one inch the remaining water is again pumped above the ice, leaving an inch as before and adding enough extra water to compensate for the inch that is left each time. This makes three surfaces exposed to the weather, as shown in Fig. 5. This process is continued until the ice house is full, the lower part being soon filled, as shown in Fig. 6.

To prevent the water from running off the edges, a wall of ice is formed by first stretching cheesecloth all around the edge and then spraying with water. The object of making the icicles is to support the large sheets of ice, which would be unable to hold the weight of the water without the use of the ice columns.

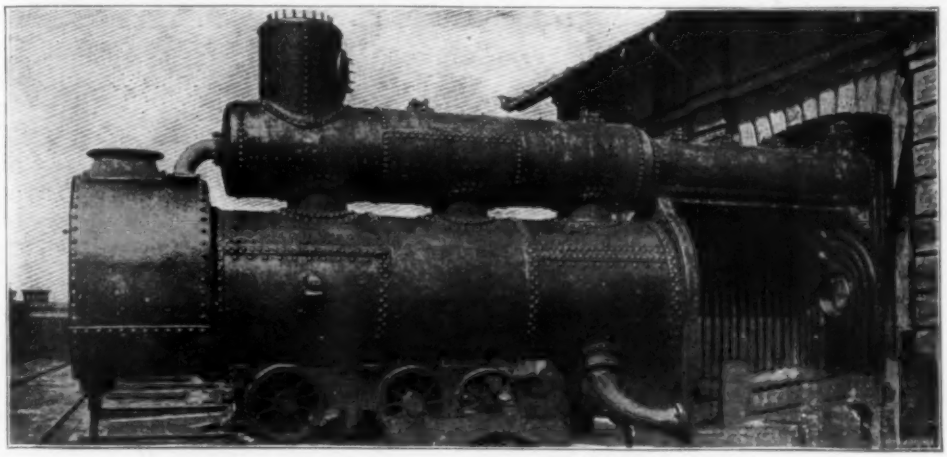
When the ice house is full, the walls are closed up tight until the ice is wanted. A small door is then opened and the ice is mined out as wanted, the cracks between the layers greatly facilitating the operation of splitting it up into symmetrical pieces of uniform size.

THE BROTAN LOCOMOTIVE BOILER AND SUPER-HEATER

This new type of locomotive boiler has been the subject of recent experiments by the Austrian and German governments. This boiler has a water tube firebox, and was designed to obviate the troubles arising from the use of copper fireboxes, especially when used with high pressures; as the tensile strength of copper decreases with higher temperatures.

The Brotan boiler consists of an upright and a longitudinal part, the latter being composed of a fire tube boiler and a steam collector with a dome, to which is connected the collector tube, arranged over the vertical boiler. The fire tube part has two round flanged tube walls made of soft steel, between which is the cylindrical shell. The whole cylindrical section from the firebox wall to the smoke chamber is filled with fire tubes of usual size, and is connected by three tubes arranged on the top with the steam collector. The smoke chamber is extended above. The steam pipe leads from the dome through the front end of the steam collector into the steam inlet pipe in the smoke chamber.

The firebox consists principally of bent tubes arranged close together and expanded at their upper ends into the collector tube. The vaultlike surface thus formed, together with the reinforced bottom of the collector tube and the circular wall of the longitudinal boiler, enclose the fire chamber like a box over the grate.



New Locomotive Boiler Now Being Tested

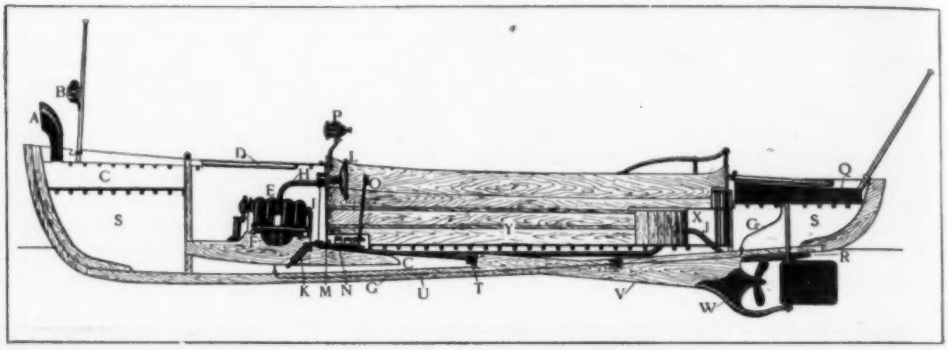
FLUID LENSES CHEAPER THAN GLASS

The largest glass lens for astronomical purposes ever manufactured is 4.92 ft. in diameter. A Hungarian chemist has a process by which optical lenses three times as large and, it is claimed, just as good can be manufactured. His process, too, is simple and much cheaper.

The process consists in enclosing a fluid substance between two unusually hard glass surfaces similar to watch crystals, the whole carefully adjusted as to refractive power, etc., and the glass hermetically sealed, so no air can enter.

Where large glass lenses cost thousands of dollars and require years to make, a fluid lens of the same size can be manufactured in a few weeks at a cost of $100, and the method is adaptable to opera-glass and other small lenses as well as to the larger ones.

A MODERN PLEASURE LAUNCH



PARTS OF A MODERN MOTOR BOAT—A, VENTILATING FUNNEL; B, HEADLIGHT; C, AIR DUCT; D, FORWARD HATCH; E, ENGINE; F, MOTOR FOUNDATION; G, FUEL PIPE; H, AIR INLET; I, EXHAUST PIPE; K, STRAINER FOR CIRCULATING WATER; L, STEERING WHEEL; M, FORWARD BULKHEAD; N, REVERSING GEAR; O, REVERSING LEVER; P, SEARCHLIGHT; Q, FUEL TANK; R, EXHAUST NOZZLE; S S, AIRTIGHT COMPARTMENTS; T, STUFFING-BOX; U, KEEL; V, SKAG; W, SHOE; X, LOCKER; Y, COCKPIT.

Pleasure launches or motor boats are rapidly growing in favor, and every lake resort now has its fleet of these boats. The great improvement in gasoline engines is chiefly responsible for their use, as motors are now so simple and reliable any one can learn to operate such a boat in a few hours. Moreover they are always ready for use at an instant's notice, and the former tedious delay of getting up steam is avoided, and the services of a skilled engineer is entirely unnecessary.

The boat illustrated is one of the latest types, and is 30 ft. long with a speed of from 13 to 15 miles per hour. The power consists of a 25-hp. 4-cylinder 4-cycle motor. The motor is placed forward under the deck and inclosed with tight fitting bulkhead doors. This not only removes the engine from sight, but the noise of its working can scarcely be heard. The arrangement keeps the cockpit free from oil and dirt.

Another new feature is the starting device. To start the engine the steering wheel is pushed in and given one or two turns. This action does not move the rudder but starts the engine, after which the steering wheel automatically resumes its former place and connection with the steering gear.

To gain access to the crank chamber the motor is simply tipped up on the two forward foundation trunnions, when the lower half of the crank case is easily removed, exposing bearings, crank shaft and cranks for easy adjustment of wear. Only a few minutes are necessary to loosen the foundation bolts, exhaust, fuel and water connections, to make the motor ready for tilting. The shaft automatically disconnects itself by means of a tongue and groove steel coupling, directly attached to the reversing gear, which drives a solid propeller. The coupling also acts as a universal joint, so that any non-alignment of the motor and propeller shaft will not cause undue strains, but always run smoothly.

The motor carries its own dynamo for supplying electricity for ignition purposes and for charging the storage batteries from which the electric head- and search-lights are operated. Besides the dynamo and storage battery, an auxiliary dry battery is also carried. This gives three independent sources of electricity for motor ignition and electric lighting. The electrical equipment is placed high and dry above the motor.

The gasoline tank is inclosed in an airtight bulkhead, and any leakage drains overboard and cannot enter the boat. Airtight compartments would keep the boat afloat even when filled with water.

A stationary center table is provided in the cockpit, on which stands an electric light; the entire boat lighting, including signal lights, are supplied from the dynamo and storage battery. A removable canopy top—not shown—can be erected or taken down in a few minutes. The American Shipbuilder says: "This is the type of boat that promises to be the forerunner of the modern pleasure launch."

ENGLISH MOUNTAIN BATTERY

The "mountain batteries" of the English artillery will climb almost anything. Kipling says of them, they "climb up the side of a sign board and trust to the stick of the paint." The illustration shows a com-

Artillery Scaling a Wall

pany engaged in wall-scaling practice, taking pieces of light artillery with them.

THE AUTOMATIC MILKING MACHINE

What has for years been declared visionary and impossible—a practical milking machine—is at last an accomplished fact and will in the near future be added to the mechanical equipment of all large farms and dairies. The inventor, who is a Virginian, worked for 15 years in perfecting it. By operating three machines he has been enabled to milk 45 cows in one hour. The exact time required, as in the case of milking by hand, depends somewhat upon how easy the cow milks. It is said to be an easy task for two men or boys in charge of four machines to milk 50 cows in one hour.

The machine proper comprises a large pail of block tin with an aluminum cover on which is mounted a pump which works automatically when connected by rubber tubes with a system of pipes extending throughout the stable. Between each two cows a branch pipe extends, to which the rubber tubing can be attached. The system of pipes at some distance away connects with a compressor which, of course, can be operated by a number of different kinds of power; electric power or gasoline engine is preferable. One size of compressor requires 2 hp. to operate it, and the next larger size requires 3 hp.

The lid of the pail in turn is connected with the teats of the cow by a rubber tube three feet in length, one end of which is supplied with four cups which fit over the

One of the first demonstrations of the power of submarine signals was entirely accidental. A workman was digging a well on Nahant, and complained that he heard a bell ringing in the ground. It was later discovered that what he heard was the sound of a submarine bell which was being operated near Egg Rock Light.

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One of the curious after-the-fire advertisements in San Francisco papers is that of chemists, who guarantee to furnish a transcript of charred papers found in vaults. The courts will probably recognize the transcripts as valid.

Milking Machine in Operation

teats after the manner shown in the accompanying engraving. There are several sizes of these cups made, in order to meet the requirements of all dairies; but the size most in use, it is said, will milk 90 per cent of the cows in any dairy. Two of the rubber tubes thus equipped are connected with each pail. As the milk leaves the cow it passes directly into the covered pail, precluding the possibility of contamination.

Milking Machine

An important feature of this manner of milking is found in the fact that cows seem perfectly satisfied with it. Were the cow not contented during the process of milking she would not yield the normal amount of butter fat. The milk is of course drawn by the power of suction, and the motion is more uniform than that of the human hand. In fact, the squeezing methods of the human hand are avoided and the machine accomplishes the work in the natural manner in which a calf sucks.

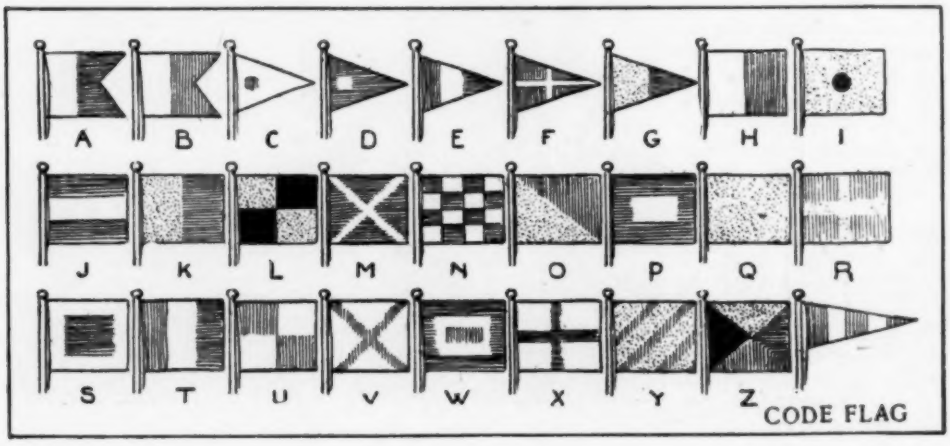
Experiments with this machine have been conducted by the inventor with 150 different cows, and some of these experiments have been conducted with one cow for an entire year. No injury whatever resulted, and as to the prolongation or curtailment of the flow of milk there was no difference over milking by hand.

FLAG TELEGRAPHY AT SEA

The Language of the Sea

By means of an old system of "wireless telegraphy," known as the International Code of Signals, vessels many miles apart can converse on any desired subject and send or receive information to the fullest degree without any apparatus other than a number of flags. These flags are shown in the accompanying illustration, where the various colors are indicated thus: Yellow by dots, red by vertical lines and blue by horizontal lines.

Each flag represents a letter, as indicated, and, as there is a flag for each letter in the alphabet, any word desired may be spelled out by hoisting the proper flags. This is not done in practice, as a message even of brief length, would consume too much time and would be very tiresome if spelled out letter by letter. Instead a code is used which deals with all matters of a marine nature and is arranged in a book in such a manner that any ordinary message may be readily



ciphered or interpreted. By this code a single hoist of flags—from two to four in number—indicates a whole sentence. For example, the flags, Q, D and S ask the question, "How does the land lie?" F, O, "Are you in danger?" and so on. Of course, any sentence that is not found in the code-book can be spelled out. In hoisting the flags they are placed one above another, thus requiring only one mast to display them, and when it happens that the wind blows in a line between two ships three solid objects, shaped like a cone, a sphere and a cylinder, respectively, are hoisted in place of the flags. By changing the relative position of these all the letters in the alphabet are represented, but this system is not as rapid nor satisfactory as the flags and is not used except when the position of the flags makes it impossible to determine their colors. Some ingenious person with inventive ability may sometime find means for keeping the flags in a position such that their colors may always be distinguished and thus obviate the necessity of carrying two sets of apparatus.

ELEVATOR SLIDES INTO RIVER

An unusual accident occurred at Ft. William, Ont., when the mammoth elevator, 190 ft. high and filled with over half a million bushels of grain, slid into the river. The elevator is of the modern steel tank and steel frame construction, which prevented its total collapse and enabled the saving of a considerable part of the contents. The Grain Dealers' Journal says:

Dredging of the river bed and the wash of the stream in front of the elevator weakened the piling at that point, depriving the concrete of its support, and the house being loaded to full capacity, the sliding into the river was a natural result. The building slid 40 ft. towards the river, and stands in 30 ft. of water. It will have to be torn down for reconstruction. The loss is $500,000.

Elevator 190 Feet High That Fell Into River

A new tunnel route is proposed connecting New York, Brooklyn and Hoboken, to be used by steam roads seeking entrance to New York.

USE OF DENATURED ALCOHOL

Domestic and Industrial Purposes Likely to Consume the Supply for Some Time

By W. A. Patton, Consulting Engineer Otto Gas Engine Works.

Perhaps no law passed by Congress in late years will exercise such beneficial results as the recent law removing tax from alcohol for mechanical and industrial purposes.

Alcohol can be produced from any vegetable product carrying starch and sugar as, for instance, the waste of sugar factories, indian corn stalks, potatoes, spoiled grain, etc., and can be manufactured for approximately 10 cents per gallon and even less under favorable conditions. This denatured alcohol must be produced under government inspection, however, which will add slightly to its cost, the government reserving the right to name the denaturizing substance to be added to it to render it unfit for drink. This substance must volatilize (change into gas) under practically the same conditions as the alcohol.

This cheap alcohol will be of immense benefit to the arts and sciences in many ways; for instance, the paint and varnish business; for lighting; cooking; the ordinary gasoline torch, and many other purposes. The writer believes that the alcohol lamp, with its incandescent mantle, clear white light, and absence of odor will practically replace the evil smelling kerosene and gasoline lamps. Alcohol can be used in gasoline engines in place of gasoline with very slight changes, the same engine giving even more power with alcohol. Slightly higher compression is required, and a good hot spark as it does not ignite quite as readily as gasoline.

The writer's personal opinion, however, is that there will be no immediate change of great importance from gasoline to alcohol in engines for the following reasons:

The demand in the arts and sciences, and for cooking, lighting, etc., will be so great that it will be some years at least before the price will be low enough to compete with gasoline for power, even at present prices. The consumption of gasoline will be greatly reduced, thus naturally lowering the price, and our old friends, the Standard Oil Company, will certainly put forth a strong effort to hold their trade, which simply means that they will cut the price.

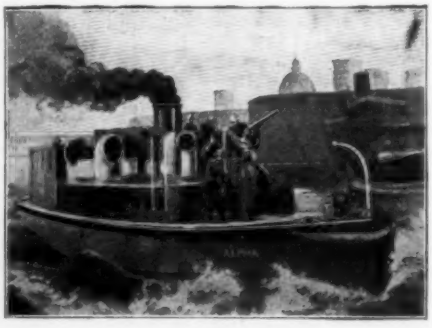
Any good gasoline engine will run equally well on alcohol and even give more power, and it will become simply a business proposition as to which will cost less. Alcohol will have a positive advantage in the point of safety and evaporation as against gasoline. Gasoline losses in shipment are large, especially in barrels and small packages, as the evaporation is so rapid any but large leaks do not show. It will not be necessary to store alcohol underground.

In the manufacture of alcohol it will not be practical to make it on a small scale. It is absolutely necessary that the government control the product to prevent its improper use. The cost of this inspection of necessity must be paid by the manufacturer (by the consumer in the end); and as an inspector could test a million gallons in bulk as cheaply as one gallon, this would prohibit the manufacture by the small consumer.

Alcohol engines are in use by hundreds in Germany and on the Continent, some of them of large horsepower; both for stationary, marine and other purposes. The superiority, however, of alcohol over city gas or gasoline for cooking and lighting purposes is such, and the enormous field in this country for its use for these purposes, will certainly make a demand that, with its increased use in manufacturing, will require all that will be made for several years to come. Later it will be used in gas engines in place of gasoline.

LONDON'S FIREBOAT "ALPHA"

The fireboat "Alpha" is a recent addition to the London fire department. The boat is a twin-screw, 80 ft. long, and will throw 1,950 gal. per minute. There is one 3-in. nozzle and four 2½-in. deliveries. The "Beta" will soon go into service with a capacity of 4,000 gal. per minute.



New Fireboat for London

TOBACCO RAISING IS THE GREAT INDUSTRY IN SUMATRA. THE WORK IS DONE BY NATIVES UNDER THE SUPERVISION OF ENGLISHMEN. THE ILLUSTRATION SHOWS THE TRAMWAY ON WHICH THE BALES ARE HAULED—SOMETIMES SEVERAL MILES—FROM THE FERMENTING SHED ON THE PLANTATION TO THE RAILROAD FOR SHIPMENT TO ALL PARTS OF THE WORLD.

A MACHINISTS' SCHOOL IN THE NAVY

The navy maintains a school for petty officers, consisting of several classes. The seaman-gunners' class is one to which men of the seaman branch who have served one enlistment creditably can be detailed and be given a thorough course of instruction in the care and operation of guns and their mounts, torpedoes, and other ordnance apparatus; another class is for men of the various ratings comprising the artificer branch; and still another school trains men (known as yeomen) for the special duties required of them in the clerical branch. The class for training electricians has already been described in these columns. There is soon to be a class for training machinists. Heretofore machinists were enlisted in that rating after having learned their trade ashore, and were given such instruction as is practicable in the engine room of a man-of-war.

In order, however, to extend to the men of the engine room force the same facilities for promotion that have been provided for the other branches of the service, it has been decided to establish, about July 1st, a school for machinists, which will be located at the Navy Yard, Norfolk, Va. The men for instruction are to be selected from the ratings of water tender, oiler, and firemen 1st class, who have served at least one enlistment and received an honorable discharge, whose marks in mechanical ability and knowledge of marine machinery are not less than 75 per cent, and who are recommended by their commanding officers. The course will be about one year in length, will comprise thorough instruction in shop work, and is designed to fit a man for the rating of machinist in the navy. The capacity of the school will be 100, 25 men to be sent at the beginning of each quarter.

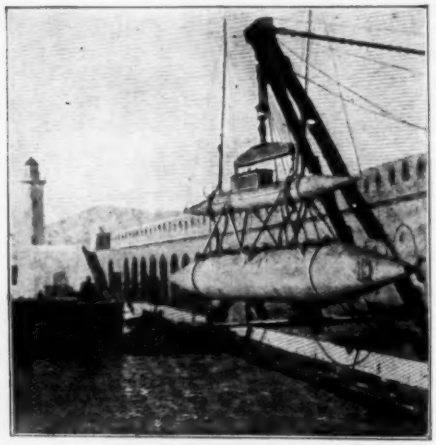
Apprentice seamen who have sufficiently good physique to stand the work, and have completed the preliminary course of instruction at a training station, are now permitted to select the rate of coal passer, if they prefer it to the rate of ordinary seaman. Men selecting this rate are eligible to advancement, as they become proficient, and vacancies occur, to firemen first and second class, oiler, water tender, and chief water tender, the latter being the leading rating in the fire room.

Men completing the course in the machinists' school will be given the rating of machinist's mate and assigned to a sea-going ship. Advancement through the enlisted ratings is open to them to chief machinist's mate, paying $70 a month and allowances. They will also have a chance to compete in the annual examination for the appointment of warrant machinists. This is a life position with all the benefits of longevity pay, commutation of quarters, retirement, etc., that other officers of the navy receive, and is in many respects a very desirable billet. The pay ranges from $1,200 a year, upon appointment, to $1,800, and allowances, which bring it up to over $2,100 per annum. Under the law twenty warrant machinists may be appointed each year.

While an ice factory at Hopkinsville, Ky., burned to the ground recently, beneath the floor the process of freezing 16,000 lb. of ice continued. The freezing cans were lowered into the brine tank just before the fire started and the ice was found on examining the ruins next day.

NEW TYPE SUBMARINE

Experiments are being made by the French government with an entirely new type of submarine torpedo boat. The craft consists of two steel chambers, one above the other



"Two Steel Chambers, One Above the Other"

and connected by steel braces. The operator is housed in the upper chamber and has communication with the gun crew and engineers below by means of a speaking tube. The exposed portion of the boat is thus made very small, and even this chamber can be submerged when required. The torpedoes are carried in and fired from the large chamber. Should the upper part accidentally be destroyed by a shot the boat proper can still be navigated.

A TOURING MOTORCYCLE

Much more attention is being given to motorcycles in France, Germany and England than here. The better condition of the

Comfortable Touring Motor

roads there doubtless has something to do with it, although the growing popularity and utility of the motorcycle is rapidly being recognized in this country.

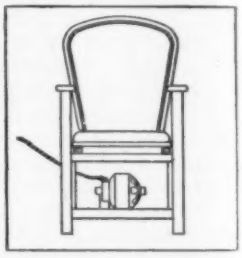
The latest French machine is a touring motorcycle in which provision is made for long runs, and also for the comfort of the rider, who is provided with a cushion seat with a back rest. The frame is hung low and built extra strong.

PAPER TIRES FOR AUTOS

A Wisconsin man believes he has found the ideal tire for automobiles. The tire is made of heavy binders' board sawed into sections corresponding to the circle of the wheel, four or more being required to make the circuit. A thick sheet of rubber is wrapped around the rim of the wheel to serve as a cushion and then the paper tire is built up, the segments being bound together with white lead. When the tire is of the desired thickness, metal plates, arranged so they do not touch each other, are applied to both sides of the tire and bolted through it. The tread of the tire is flat.

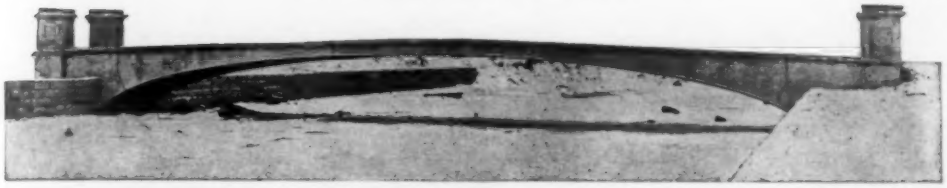
APPARATUS TO PREVENT SEA-SICKNESS

To some people, the idea of a sea voyage is always accompanied with such feelings of horror and dread that all the pleasure of the trip is lost. All who have ever suffered in this way will probably be interested in the device illustrated herewith, which is the invention of Messrs. R. and W. Otto, of the Sanitas Electric Co., Berlin.



The device consists of a chair with an electric motor attached in such a manner that the seat is caused to vibrate. The seat rests on springs which allow it to vibrate up and down very rapidly. The inventors explain that this rapid vibration counteracts the slow vibration of the ship, and actually prevents the outbreak of the sickness. The sensation experienced while sitting in the chair is not at all disagreeable, being similar to that felt in the jar of an automobile, and so long as the vibration continues the motion of the boat cannot be detected.

In recent tests the most susceptible persons have found absolute comfort while sitting in the vibrating chair.

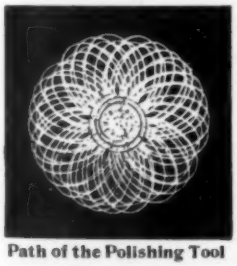


FLATTEST ARCH BRIDGE EVER BUILT

The flattest semi-elliptical bridge in the world was recently built in Brookside Park, Cleveland, O. It consists of four pieces, and each piece was completed in a single day. The bridge, which is 86 ft. between abutments, contains no longitudinal reinforcements whatever. One enormous steel hinge is imbedded in the concrete at the crown, and one at each of the abutments, thus giving the structure freedom to adjust itself to all conditions. The concrete mixture was: 1 part portland cement; 2½ parts crushed limestone, and 5 parts sand. The falsework to support the arch, while in process of construction, was no small part of the expenses, for the reason that it had to be absolutely unyielding in every direction and sufficiently strong to carry the weight of the arch, amounting to more than 500 tons exclusive of the hinges; there was, however, not the least deflection noticeable in the centering when the concrete was placed in position. The top of the arch was thoroughly waterproofed by being carefully covered with a thick coating of asphalt gum and the spandrel walls were all faced with mortar.

HOW HIGH-GRADE PHOTOGRAPHIC LENSES ARE MADE

While the skill exercised by optical workmen is probably less apparent than that of many other industries, it is acquired only by an experience extending over many years. One of the operations which require particular attention is the polishing, as the path described by the polishing tool has a marked effect on the accuracy of the lens.



Path of the Polishing Tool

During the process of polishing, the lens is revolved by a vertical spindle, which is connected to a second spindle, having an adjustable eccentric which moves the polishing tool. This construction is similar to that of the machines used for engraving the fancy curved lines on paper money, and the path described by the polishing tool also resembles the designs on bills, as may be seen from the illustration, published by courtesy of the Optical Journal.

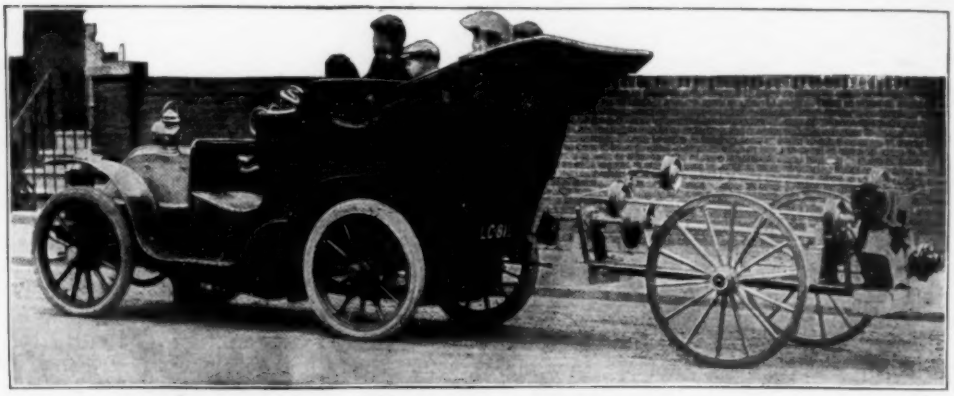
During the process of polishing the lenses are held by sealing wax, which is warmed slightly before the lens is applied. When one side of the lens has been polished it is lacquered to protect the surface and when dry it is again applied to the sealing wax. In applying this time it is necessary that the center lines of the two surfaces should exactly coincide. To do this the sealing wax is warmed, and while the lens is slowly rotated, the reflection in the lens of some clearly defined object is watched to ascertain if the lens has been fastened in the right position. If the lens wabbles the least bit the object will appear to move, and the operator will then press the lens with a small tool until the reflected image stands perfectly still.

After being polished the lenses are tested by means of test glasses, in which the perfection of the lens is indicated by the appearance of rainbow colors. They are then examined by powerful microscopes to discover any possible scratches, after which they are mounted in carefully turned brass mountings.

The objective lenses of microscopes, while not as expensive as photographic lenses, are probably more expensive than any other article, of equal weight, in the world. These lenses, which are smaller than the head of a pin, often cost over $5.00, which is about five hundred times the cost of an equal weight of gold.

It has been estimated that one pound of these lenses would be worth over $6,000,000, which would be over sixty million times the cost of the plain glass used in making them.

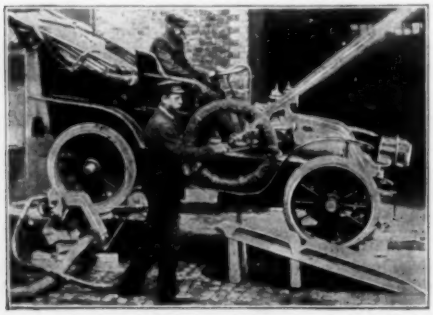
AUTOMOBILE AS FIRE ENGINE



Fire Pump Mounted and Attached to Auto

An ingenious apparatus has been put on the English market, and is being successfully used, whereby an automobile can be made to do duty as a fire engine, or to pump water for domestic purposes.

A fire which destroyed a costly summer home, far from any fire department, was the occasion which suggested the invention. The pumping outfit is carried on two wheels and can be towed to any place the auto can go. To put the pump into action, the frame is taken from its carriage and placed on the ground, when the driving wheels of the auto are raised and placed on the friction wheels of the frame. These friction wheels are on the shaft which drives the pumps. The suction and discharge hose are then connected and the motor started up. An incline is provided for running the motor car up on to the friction wheels. Instead of a pump, a saw, small grinding mill, or other machinery can be operated in the same manner.



Auto Working Pump

PASSENGER CARS TO BE COOL AND DUSTLESS

Success is now claimed for an invention by an employe of a sleeping car company, which automatically cools the air in a passenger or sleeping car, and at the same time removes the dust. The Pullman Company has for years had a standing offer to its employes of a large reward for an improvement in car ventilation.

The device is simple and consists of a boxlike apparatus which fits closely over the deck sash of the upper windows. By a clever arrangement of traplike compartments the air is made to rush into the box with the movement of the train and out again. This movement of air creates such a draft that all the superheated and foul air and all the dust and dirt are drawn into the box and blown out of it by the suction which is created.

The device does not include an arrangement for the introduction of fresh air into the cars. At present partial dependence is placed on open doors and windows for fresh air. In the experiments made on the dining car of the Baltimore and Ohio special it was found that the car was 15° cooler than another car which was not fitted with the device. Eight of these ventilators are placed in an ordinary twelve or sixteen section sleeping car. Experiments have also been made in crossing the deserts, and it is stated that the new ventilators are efficient in eliminating from desert travel nearly all the choking dust which attends it.

WOMAN PAINTED SIGN ON SKY-SCRAPER

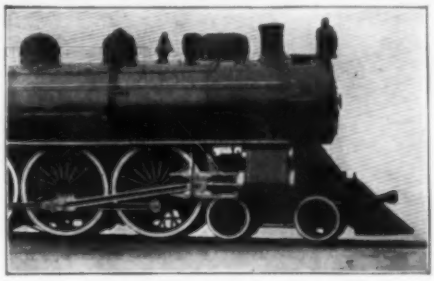
Had you walked down State street, Chicago, that summer morning you would have first noticed the gaping crowd, and then following its intent upward gaze, would yourself have paused to gape and wonder. For there, on a slender board scaffolding 200 ft. above the sidewalk, slung from the top of one of Chicago's skyscrapers, a young woman, oblivious to the comment she was exciting, was painting a 30x20-ft. sign on the wall, and doing a good job, too. The young lady was clad in a snowy linen gown that had never a splash of paint on it and from under her white linen hat her long braided hair hung down her back in a surprisingly feminine fashion. Her presence there was an object lesson in modern advertising methods, her own bright idea, and was to bring her handsome remuneration, so what did she care for the loafers' comments on feminine temerity. The watching crowd became so great, however, that the police arrested the young woman on a charge of "disorderly conduct, inciting a mob," instead of sailing into the mob with drawn clubs. Here is another object lesson of the law's partiality and miscarried justice. Will woman *never* get her rights!!!

ARMY STEAM AMBULANCE

The largest steam ambulances ever built were constructed recently for the Portuguese government for use in its expedition in West Africa. As the vehicles will have to travel over extremely rough roads and through the mountains, special spring-supported gears were used. Each ambulance weighs 5 tons and is propelled by a 45-hp. steam engine, which with the boiler is carried at the front. The compartment has spring bunks for eight men. On account of urgent need these vehicles were built in 39 days.

ELECTRIC PLANT ON LOCOMOTIVE'S BACK

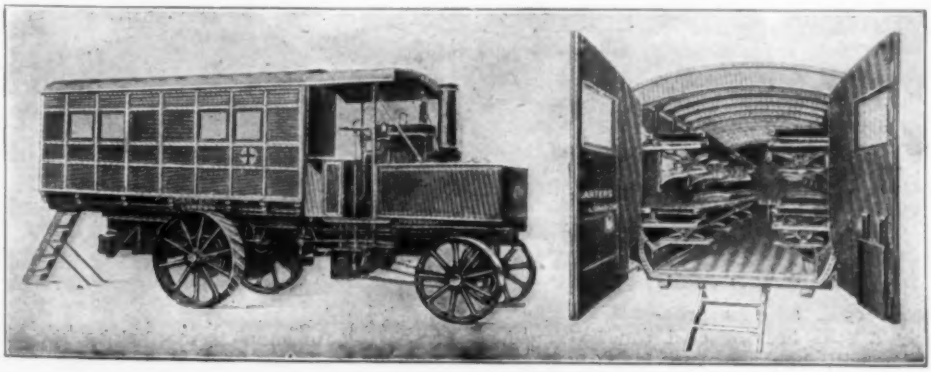
Observers of modern locomotives have probably noticed a device attached to the top of the boiler as shown in the illustration. This device, which is a complete electric plant, is usually attached between



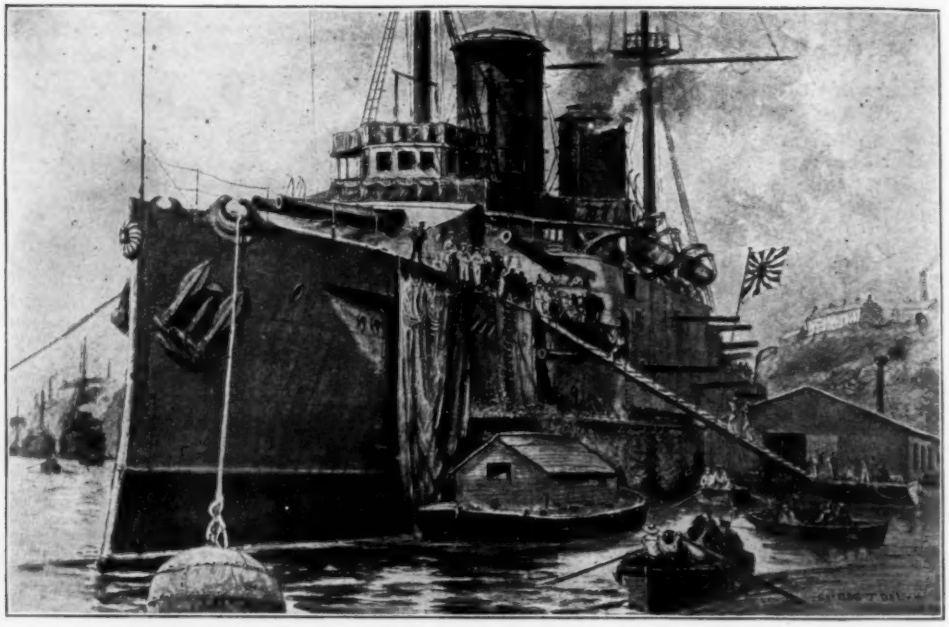
Turbine for Train Illumination

the stack and the sand box, but is sometimes placed back of the sand box. It consists of a small steam turbine, direct-connected to a very compact two-pole generator, and has all electrical connections and moving parts carefully protected from the weather.

This apparatus is the survival of several other appliances for train illumination among which were storage batteries, generators driven from the car axles, and small reciprocating steam plants in baggage cars, all of which proved inferior to the steam turbine for efficiency and reliability.



Portuguese Steam Ambulance for Use in Africa

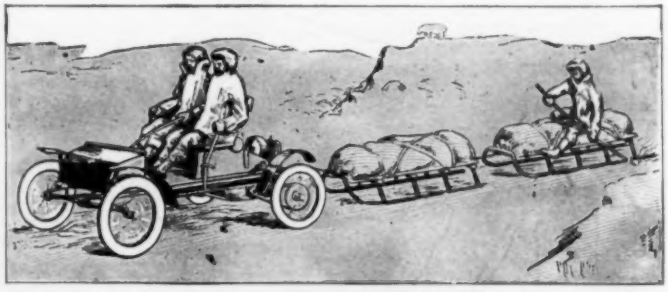


THE NEW TWIN BATTLESHIPS FOR JAPAN, THE "KASHIMA" AND THE "KATORI," BUILT IN ENGLAND, ARE NOW COMPLETED FOR SEA. THEY ARE TWIN SHIPS OF 16,400 TONS DISPLACEMENT. THEIR LENGTH IS 455 FT., THEIR BEAM 78 FT. THE ARMOR IS KRUPP AND THE GUNS ARE ELSWICK. THE ARMAMENT CONSISTS OF FOUR 12-IN. GUNS, FOUR 10-IN., TWELVE 6-IN., TWELVE 12-POUNDERS, THREE 3-POUNDERS, SIX POMPOMS, AND FIVE 18-IN. SUBMERGED TORPEDO-TUBES. JAPANESE OFFICERS AND CREWS WILL SAIL THE BATTLESHIPS HOME.

TO EXPLORE GREENLAND IN AN AUTO

An American-built auto of the buckboard type has been secured for use by the expedition exploring Greenland under the auspices of the Government of Denmark. Myhus-Erichsen, who has had charge of the work for several years, is confident the motor car, which weighs only 550 lb. and is driven by a 4-hp. engine, will prove a great success.

The Politiken, a leading newspaper of Copenhagen, says: "The gauge of the car is very broad, so that it will not easily upset, and the whole machinery is simple and well covered. As gasoline freezes at about 40 degrees Centigrade cold, and as probably a still heavier cold can be expected, there will be made an arrangement for warming purposes worked with pure alcohol, which only freezes at a lower temperature, and by means of which the gasoline will be kept liquid in the tank. Around the rubber tubes of the wheels there is not a rubber cover, which would break in the cold, but a cover of leather or linen. The car will be arranged to be placed on sleigh runners, so it can be drawn by dogs and men if loose snow is met with. It is the intention all the time to have dogs beside the car, so that it can always be transported



For Negotiating Greenland's Glaciers

if the machine should break. There is no doubt that the automobile can be used to advantage on the East Greenland fjords, which are often twenty and thirty Danish miles long (a Danish mile is equal to 4½ English statute miles), where the ice will be lying even and smooth for months, and if Erichsen succeeds in bringing the car up the valleys of the glacier territory to the plateau, he will also try to drive it over the never-crossed northern ice of Greenland's upland region."

"TEAM-WORK" IN WAR

By Major George O. Squier, Signal Corps, U. S. Army, Assistant Commandant of the U. S. Signal School

The underlying cause of the Russian defeat by the Japanese in the recent war was irresistible "team-work." The Japanese infantry soldier was no better, their artillery material and their cavalry were inferior, the numbers engaged were approximately the same; yet from the beginning to the end of the conflict the Japanese were successful. Never before in the world's history has there been seen a gigantic team of forty millions of people bending every effort so completely to one common purpose at one given time. From the Emperor of Japan to the lowest coolie in the rice paddies at home, each did his part, great or small, to defeat Russia. On the one side were organization and combination of effort, while on the other were disorder, lack of harmony and intrigue.

The principle of "team-work," when applied to guide human endeavor, is the paramount discovery of the present century. It is the principle which has made it possible for the Standard Oil corporation in a minimum time to plan a campaign and defeat its enemies in any part of the world. It is the principle which enables the citizen to travel in comfort and safety from Chicago to San Francisco, a distance of 2,000 miles, in less than three days. It is the principle which has concentrated at San Francisco, after the recent appalling earthquake disaster, unprecedented assistance and succor of all kinds. In fact, it is this industrial discovery which has placed the United States ahead of the world in material progress.

The one unchanging factor in warfare is the individual physical strength of a man. The soldiers of Cæsar's army were physically no stronger nor weaker than our own. Progress in the art of war, therefore, consists in the realization of certain fundamental conceptions from time to time, and the seizure of one idea at a time, working it out in detail, and applying it before an enemy realizes its importance. These fundamental ideas have been slow to impress themselves upon military leaders, and, therefore, that nation which first takes hold of a new fundamental principle of war, and works it out with the greatest perfection in time of peace, possesses an insuperable advantage when suddenly the conflict is precipitated.

Frederick the Great inherited an army which had been trained in peace, and he soon found that he could march all around his enemies and strike them where he pleased. Napoleon, for the first time, grasped the importance of the relation between the ground and the battle, and developed this single idea until the French nation led the world in war. The electric telegraph was then unknown, but it is not too much to say that if there had been on duty with Napoleon's army at Waterloo a single trained company of signal troops, such as is now at the U. S. Signal School, the history of modern Europe would probably have been different.

The strictly modern art of war began with the campaign of Metz and Sedan in 1870. The greatest of the fundamental ideas introduced in the art of war at that time concerned the mobilization and accurate assembling of great armies upon the field of battle. The army of the North German Confederation in the peace establishment numbered 12,000 officers, 285,000 men and 73,000 horses. The order to mobilize was telegraphed on July 16. Between July 23 and 25 the army was increased to 22,000 officers, 932,000 men and 193,000 horses, ready for war. The mobilization having been completed in eight to ten days, in eight to ten days more a force of nearly half a million of men and 1,200 guns, with first and second lines of trains complete, was assembled on a line of about ninety

miles from Treves to Germersheim waiting for the order to advance. This result was effected by using railroad facilities to an extent unknown before.

With the increased accuracy and range of military weapons and the great size of modern armies, a modern line of battle, as at Mukden, may extend a hundred miles or more, and involve a terrane with widely varied military features.

The most fundamental truths are usually learned from the simplest experiments. Did not the falling of an apple give us the great law of gravitation?

A modern battle may be likened in many respects to that of a foot ball game on a grand scale, in which the various elements of an army correspond to the individual players of the team. The end players correspond to the cavalry on the flanks; the center, guards and tackles to the infantry and artillery of the front line; and the half-backs and full-back, to the supports and reserve, ready to be thrown into the line at a weak point. Offense and defense depend upon which side has the ball.

It is not, therefore, the efficiency of the separate arms of the service which measures the strength of an army; it is their complete co-operation and mutual support; or more definitely, the strength of an army is measured not by the number of men it contains, but by the number of rifles and guns it can put into effective action at any one time. It is a significant fact to note in this connection, that during the entire Civil War there was never a battle in which there were more than 20,000 men engaged on either side at any one time.

Electricity is a messenger which travels at a rate of over seven times around our earth in one single second of time, and is therefore practically instantaneous for any distance involved in war, whereas any other available messenger requires not only an appreciable time to travel one mile, but of necessity requires twice that time to accomplish two miles.

It must be evident then that the only way to attain that perfection of control of the different units of an army which success demands, is through electrical lines of information which follow all the movements of the elements of an army and enable the commander-in-chief to operate his entire force at all times, with the same precision he would attain were he directing the movements upon a map before him. In short, it must be possible for the commander-in-chief of an army, surrounded by his expert staff, to remain in his tent, and from the map before him play the game of war over a front of a hundred miles with the overwhelming force of perfect "team-work." He need not, and best should not, be distracted from his great responsibilities by the excitement incident to proximity to the actual combat. The only hope of securing this is by the development and use of electrical lines of information by highly trained signal troops in number far exceeding that authorized at present for any army in the world. This service must be insured at any cost, since it is the service that welds the whole army into one massive team, capable of being handled by one central intelligence to carry out a definite plan at a definite time.

The professional task before the army at present is to apply to the utmost the principle of combination of effort to a single purpose in the shortest possible time; in short, it is the attainment of the complete co-operation of the different arms. In general terms, the army which can effect this co-operation to the highest degree, other things being equal, will win in war.

During the past few years we have devoted money, energy and skill to the efficient development of electrical means of *fire-control* for our coast artillery, and more recently to applying the same principles to field artillery, but the professional problem of the present is that of complete fire-control for an army in the field.

Military strategy is impossible today, and always has been impossible, without the possession of information of your own situation, that of the enemy, or of both, which is not possessed by your opponent.

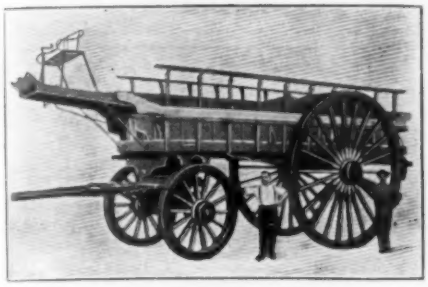
The United States now has the three arms of the service, each of which compares favorably with the same arm in any other army. We have efficient regulations for the training of each of these arms separately, but we have as yet reached no full appreciation of the results to be attained by the complete co-operation and support of the different arms of the military service operated as a gigantic *war-team*.

In an attempt to cross the Alps in a balloon, three distinguished Italian aeronauts were carried over the Appenines and dropped into the Adriatic, several miles from shore. One clung to the ropes for four hours and was finally rescued, the others drowned.

In France another tree must be planted for each one cut down for manufacturing purposes.

AN ARGENTINE WAGON

This immense wagon, weighing 17 tons, is common in the Argentine Republic, for hauling grain to market, often 100 miles or



For Hauling Grain to Market

more. The American Thresherman says: "The rear wheels are 11 ft. high and 20 horses are required to haul this great vehicle and its load of sacks of grain."

COBALT TO MAKE AUTOS CHEAP

Recent Discoveries of Vast Veins of the Mineral in the United States

Thomas A. Edison predicts cheap electric automobiles in the near future, as a result of his discoveries of cobalt, a mineral necessary in making storage batteries for power purposes.

When at Asheville, N. C., recently, Mr. Edison stated: "By the use of cobalt I will reduce the weight of storage batteries in automobiles 50 per cent and the cost of traffic in cities 55 per cent.

"There is a streak of cobalt running from a point just east of Nashville, Tenn., into this state, and I must add that some of the richest beds I have found have been in North Carolina. My discovery means a revolution in the electrical world.

"It can be seen very readily that more automobiles and electrical vehicles will be built because the cost will be placed within the reach of many people who cannot afford to own them now.

"The electric vehicles have been under a great handicap because of the very heavy storage batteries we were forced to put in them, and also on account of their high price. When I can equip an automobile propelled by the cobalt system the weight will be one-half, thereby giving the new machine an enviable advantage over the ones now in use, and when the price is reduced so as to place them within the reach of everybody it means that the horse is a thing of the past.

"I have left a force of men in four counties in this state where I found the mineral, and they will make thorough investigations as to the quantity to be found. They will report to me, and I may return here later in the summer and further investigate my discoveries. I am fully confident that what I have found here will enable me to start out on the work of new vehicles propelled by cobalt batteries. Most of the cobalt now known to the scientists of the world is found in France and Australia, and American industries are hampered because of the distance it is from the manufactories."

SUBMARINE DIVERS UNDERGROUND

An unusual use of divers was recently made in saving Winchester Cathedral, England. During repairs to the foundations a large water main burst, filling the excava-

Diver Working Under Church

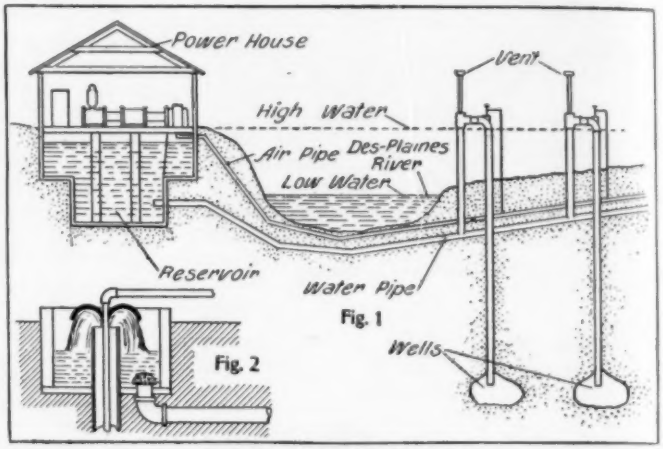
tion and crypt. For some days it was feared the noble structure would collapse, but divers were sent down, the rush of waters stopped, and the building saved.

COMPRESSED AIR PUMPING PLANT

While compressed air has been used for raising water for many years, the plant at Desplaines, Ill., offers some new features which were made necessary by local conditions, and a departure from general practice, necessary to insure against any interruption to its operation throughout the entire year.

The general arrangement of power house, pumps and pipes is shown in Fig. 1. The air from the compressor is conducted to the pneumatic pumps, where it enters a small pipe inside the large vertical pipe, and is carried nearly to the bottom of the well. As the air is released it mixes with the water and rises in the pipes. At the top the air is released and passes out of the vents, while the water drops in the short vertical pipes, and passes to the reservoir.

It has been the usual practice to use auxiliary reservoirs at the top of each pump, as shown in Fig. 2, but it is evident that this could not be done in the plant under consideration, as the river at high water would overflow the small reservoirs. Another advantage of the new type over the auxiliary reservoirs is that the wells are closed against interference by the public and are practically tamper-proof, preventing the introduction of foreign substance.

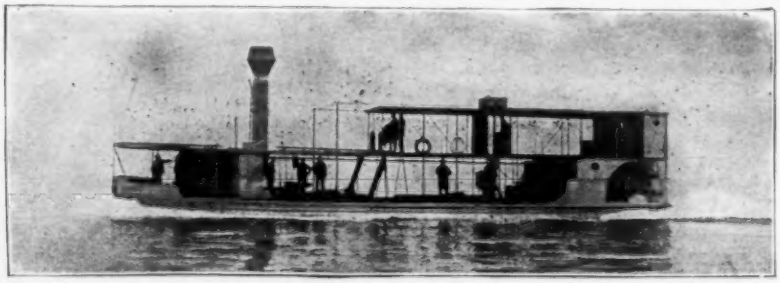


Compresced Air Pumping Plant

A NORTHERN NIGERIA STEAMER

Vessels for use in the tropics are built to conform with the peculiar conditions. Nearly all are of the shallow-draught type and quite small. Many of those in use on the inland lakes are built in England or the governing country and shipped in pieces, untried until they reach the waters in which they are to ply. Some very bad blunders have resulted from this practice; two vessels for freight and cargo service on Lake Victoria, when re-erected, were found to be 18 in. over draught, or 150 tons heavy, says the Shipping World, London.

The "Karonga" is a stern-wheel steamer used in Northern Nigeria. Her dimensions are 75 ft. by 18 ft. by 3 ft. 6 in. by 16 in. draught; indicated horsepower, 135; speed, 9¾ miles.



Shallow Draught Nigeria Steamer

When you are in need of any machine or tool and do not know where to find it, write to Popular Mechanics for information.

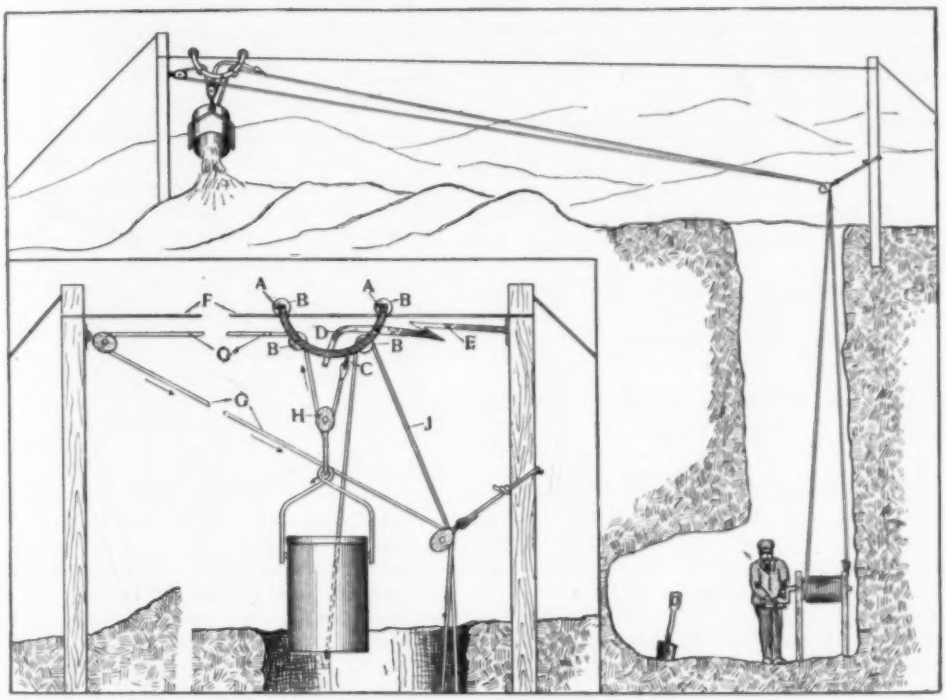
All the articles appearing in this department are reprinted in book form at the end of each year.

SHOP NOTES

Contributions to this department are invited. If you have worked out a good idea or know of one, please send it in.

ONE-MAN HOIST AND AUTOMATIC DUMP

By H. E. Bowcher, Dawson, Y. T.



Details and General View of Hoist

Having had considerable experience as a prospector, and not finding a suitable prospector's device for excavating, I decided to make one, and constructed the apparatus about to be described. This device enables one person to sink a shaft of practically any depth and hoist the dirt from the shaft and take it away and dump it at a distant pile, without having to come out of the shaft to operate it, as the windlass is located down the shaft. The device weighs but 15 lb., and can be carried readily in the prospector's pack.

The trolley frame, A A, is made of flat iron or steel, ⅛ in. thick by 1½ in. wide. When bent to shape as shown, the ends, A A, are about 20 in. apart.

Six holes are drilled in the frame; four to receive the grooved wheels, B B B B; one for the ring, C, and one for the trigger, D. This trigger catches on the hook, E, and locks the trolley in place, until the pulley, H, strikes the trigger, thus releasing the trolley and allowing it to travel along the steel wire cable, F.

The rope, G, is connected to the windlass and moves in the direction indicated by the arrow when the windlass is being wound up. This movement of the rope, G, has a tendency to raise the bucket and move the trolley on the cable at the same time, but as the trolley is locked at E, it will not move until the pulley, H, strikes the trigger. The bucket by that time having left

the shaft is ready for its trip to the dumping pile.

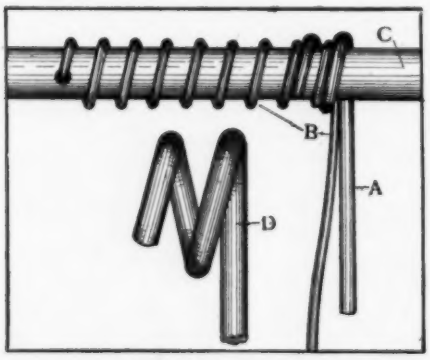
A second rope, J, is fastened to the bottom of the bucket at one end, the other end being secured to any fixed object in the bottom of the shaft. This rope is fastened at such a length, that the bucket on reaching the dumping pile will be turned over, the rope having traveled its entire length. The trolley cable being slightly elevated at the dumping end causes the bucket to return to the shaft by gravity.

When ready to hoist, the operator starts the windlass at the bottom of the shaft, which causes the bucket to ascend until the pulley, H, strikes the trigger. The trigger is then released from the hook, E, and the traveler moves with the bucket to the dumping pile, where it is dumped by the rope, J, as stated above. The traveler then returns to the shaft, by gravity, and is locked in position by the hook, E. The bucket then descends the shaft ready for the next cargo.

I had this device in successful operation for many years in Australia and am using it at present in the Klondike.

HOW TO MAKE A SIMPLE SPRING WINDER

A good spring winder, suitable for use in a lathe, can be made by bending a piece of stiff wire to the shape shown at A in the sketch, and in detail at D. The wire, B, of which the spring is to be made should be smaller than the wire used for the winder, as the pitch (distance between coils) of the spring is determined by that of the winder.

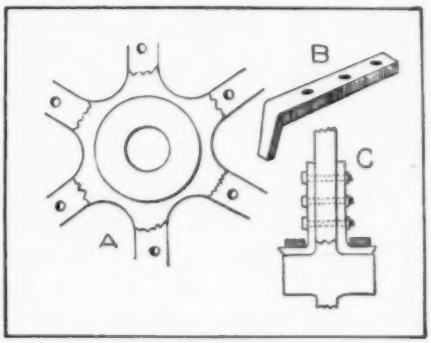


Simple Spring Winder

If the wire of which the spring is to be made is very heavy, the winder should be made of a flat strip of steel, in place of wire, as this is more easily bent to the required shape and is more rigid. The arbor, C, determines the inside diameter of the spring, and should always be used in connection with this winder.—Contributed by L. G. Harren, 14 Barnett St., New Haven, Conn.

HOW TO MEND A BROKEN DRIVING PULLEY

All the spokes on a driving pulley from a 40-hp. engine were broken at the hub as shown in the sketch at A. The pulley was mended by a correspondent of the American Blacksmith as follows:



Mending a Pulley

Two pieces like B were made and bolted on the foot to run out over the hub and ⅛ in. off, as shown at C. These were used on each spoke and when all the pieces were on, two rings 1½ in. square (shown in section at C) were driven on hot and allowed to shrink on the feet, thus drawing the spokes down tight. The engine has been used a long while since the repair was made and the job still holds good.

TO FIND CENTER OF SQUARE OR OBLONG CEILING

Rub the line with chalk or charcoal and stretch it across the ceiling from diagonal corners. Two persons will be required to do it. The point where the two lines cross each other, says the Master Painter, will be the center.

If there is a deep chimney breast abutting out into the room stretch the lines from corners made by drawing a line across the breast, and not from the true room corners. This in order that the center may not appear too close to the breast.

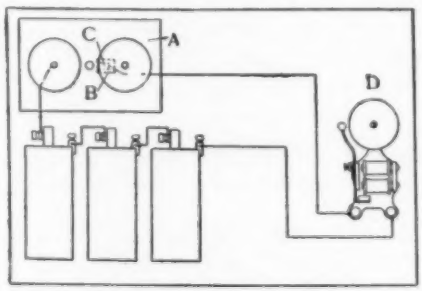
TO DUSTPROOF A WATCH

During long automobile tours, fine dust and grit is sure to clog the works of one's watch, sometimes causing it to stop just when most needed. To prevent this, says the Automobile, cut a match chisel-shaped at one end and with it apply a thin coat of vaseline all about the seat of the case where the lid fits. Treat the back and front lids both in the same manner. This will make the watch dustproof and waterproof.

EXTENSION CALL BELL FOR A TELEPHONE

In many shops, where the telephone is in the office and the proprietor spends a great part of the time in the shop, the telephone often rings repeatedly without being answered, as there is nobody within hearing distance. In many cases of this kind an extension call bell, such as is shown in the sketch, could be used to advantage.

The telephone bell, A, is fitted with a piece of hard rubber, B, having a metal contact, C, which is placed so that the hammer will strike it and make contact. Part of the gong may be cut away to do this, or if necessary, the whole gong may be removed. The other gong is connected to one side of the battery, and the other side connects to an electric bell, D, which can be placed in any desired location. If the bell does not work well, short circuit the interrupter. This will not prevent it from vibrating, as the current is intermittent, being



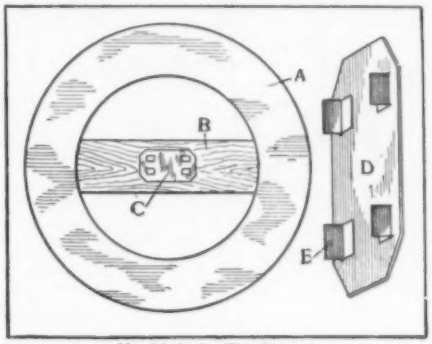
Extension Call Bell

interrupted at C, and if the interruptions at C and D are not in unison the result will not be good.

I have one of these bells in use at the present time and find it a great convenience. —Contributed by Frank H. Kimball, Ballston Spa, New York.

A HANDY TIN CENTER FOR MACHINISTS

In locating the centers of castings, such as the flange shown at A in the sketch, most machinists use a piece of wood, B, and find the center by means of a compass or calipers. The center is then marked on the wood, and the drilling or other work to be done is laid out from the point thus



Machinist's Tin Center

located. A piece of tin plate nailed to the wood makes a better working surface than the wood alone, but most machinists dislike the trouble of finding the nails and fastening the tin to the wood.

To obviate the use of nails, and to provide a tin center which can be easily and quickly applied, J. G. Campbell, 404 N. E. Border St., Cleburne, Texas, devised the center shown at C in the sketch, and in detail at D. This center, which can be made in one operation with a blanking and forming die, is made of medium heavy tin plate, and is provided with four tongues, shown at E, which take the place of nails. To fasten it to the wood, simply lay it on the desired location and strike two or three blows with the hammer.

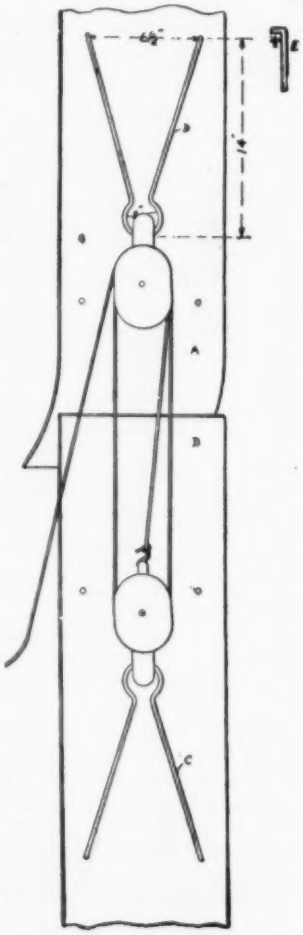
HOW TO FROST GLASS

Glass cutters' sand and water, or even clean, washed sea sand rubbed on with a smooth block of marble will produce a frosted appearance on glass, says the Master Painter. Finish with emery for a fine appearance.

A fair imitation of frost may be produced by a hot solution of Epsom salts and gum arabic water. Apply warm. Strong alum water gives the same effect, but with neither of these last is the result durable.

ADJUSTABLE TIGHTENER FOR ELEVATOR BELTS

A tightener for elevator belts is shown in the illustration. A and B represent upper and lower ends of elevator belt; C and D are hooks made of $\frac{5}{16}$-in. spring steel, bent in round ring 2 in. in diameter, to receive lug of awning pulley; E, ½-in. hook at top to hook in cup bolt holes, from which cup has been removed. The pulleys are common awning pulleys, one double and one single. As it is impossible to get an awning pulley with becket, F, a screw-eye can be tapped into the end of the single block. A common sash cord is the best and strong enough to bend any head shaft. To hold the belt after it has been tightened, and while the splice bolts are being put in, pass the pall or pulling end through under the other strand, as per dotted line, G, and pull it up tight against the pulley. No other knot is necessary, says the American Miller. The spring steel hooks are readily adjustable to any width of belt.



The town of Ringwood, Okla., has established a municipal cyclone refuge—a large centrally located cave or cellar—and has appointed a cyclone crier to arouse the people on the approach of a storm.

TO CLEAR SEDIMENT FROM ENGINE PUMPS

Sometimes a quantity of the sand used in the foundry in making the castings remains in the water jackets of cylinders and, becoming loosened by the circulation of the water, finds its way into the pump when it is fitted low and close to the motor, to the disconcertion of the motorist who is his own chauffeur. With centrifugal pumps, this sand tends to wear away the pump vanes, says the Automobile, and in a new car it is advisable to occasionally disconnect the pump and clear it of sediment.

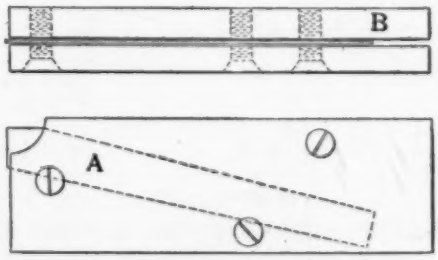
Many rotary pumps set up end thrust which forces the vanes up against one side of the pump and in time wears them down, until the pump leaks and fails to circulate the water. A simple temporary remedy is to solder a strip such as a short length of wire, along each of the worn vanes, but a permanent cure can only be effected by putting in a new thrust bearing.

RECIPE FOR FRENCH PUTTY

Boil in raw oil about half the weight of umber, says the Master Painter; then slowly add dry white lead and whiting. Mix the mass thoroughly.

OLD HACKSAW BLADE FOR CUT-OFF TOOL

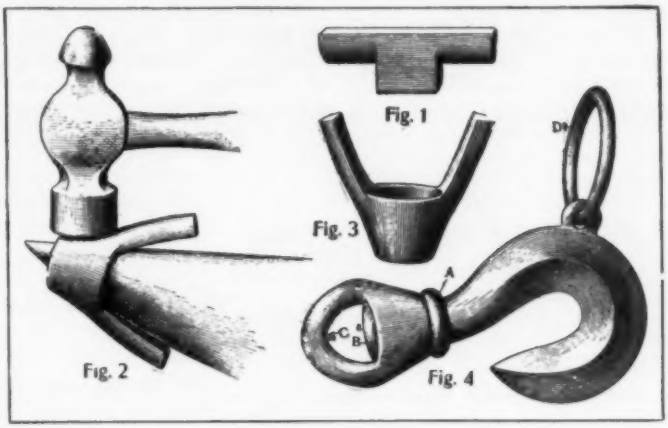
For cutting up brass tubing the tool here shown will be found very useful. A thin piece of steel, A, is ground to the shape shown in the sketch, and firmly clamped between two pieces of 1x¼-in. steel, B, if the hole in the tool-rest of the lathe is large enough to admit that size; if not, use 1x$\frac{3}{16}$ in., or some size that will suit the dimensions of the tool-rest. A correspondent of Machinery used an old hacksaw blade for the part, A, and found that it worked perfectly.



Cutting Off Tool for Brass Tubing

HOW TO MAKE A SWIVEL HOOK

A good swivel hook may be made by the following directions, which are given by a correspondent of the Blacksmith and Wheelwright: It is all constructed of Swedish iron. Fig. 1 shows the piece of iron which has been cut down at each end to one-half round as shown. Then turn the ends up, and punch a $\frac{5}{8}$-in. hole. Turn the top end over the horn of an anvil, as shown in Fig. 2, and hammer until the top is beveled or countersunk so as to make it $1\frac{5}{16}$ or $1\frac{1}{2}$ in. across the top. At the bottom where the hook goes up through it should be $\frac{3}{4}$ in. This leaves it as shown in Fig. 3. Then the hook should be made of 1-in. square iron, as shown in Fig. 4. Use a collar of $\frac{5}{16}$-in. round iron welded on as shown at A, and have the shank rounded down to $\frac{3}{4}$ in. Heat the shank well and place it in the vise. Put the swivel on and pound the shank down level with the top of the swivel as seen at B. Then heat and turn the swivel around so that it may move freely. Weld the two shanks together as shown at C.



Making a Swivel Hook

Finally put on a 3- or 4-in. hinge to handle the hook by when attached to the whiffle tree, as shown at D, and you have a complete swivel hook.

SUNSTROKE--INDICATIONS--TREATMENT

There are two forms of sunstroke. The mildest is that known as heat exhaustion. This manifests itself in the case of people who are overcome by heat without being actually sunstruck. In this form the skin is pale, cold and clammy, and the pulse feeble. While death sometimes results, the patients under good treatment will usually recover. Persons affected in this way should be removed to a shady spot and have their heads and chests dashed with cold water. Spirits of ammonia (hartshorn) should be applied to the nostrils, and sometimes it is necessary to administer small quantities of stimulants.

Heat stroke or insolation is the serious form of this trouble, and the one to be most closely guarded against. In cases of real insolation the face becomes purplish, eyes bloodshot, veins swollen and corded and the skin dry and burning hot to the touch. It is not always fatal, but many of those whose lives are saved are ever afterward invalids, with brain power more or less impaired. The effect of the sun's heat seems to be most marked on the brain and spinal marrow. When real insolation occurs the brain becomes so heated that the human "heat center," controlling the production of bodily heat, is affected and the temperature rises from the healthy mark of $98\frac{1}{2}$ as high as 110 or over, and often keeps on rising for some time after death. The "heat center" lies at the back of the head and should be protected from the direct rays of the sun.

Insolation is so dangerous that a physician should be called as soon as possible. While waiting the doctors' arrival much good can be done and life often saved by applications of ice to the head and spinal column. It is best broken in small pieces and placed in cloth or rubber bags, but when these are not to be had, ice can be placed directly about the head and neck.

Workmen and others exposed to the direct rays of the sun should have their heads well protected and should wear woolen next to the skin. A very useful precaution is a pad of cotton batting or flannel sewed along the back of the undergarment so as to cover and protect the spine.

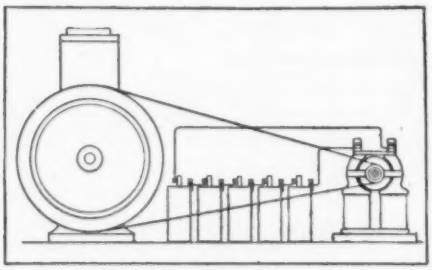
It is well to bear in mind the old rules: Keep cool as to temper and your body will

not get so hot; avoid all alcoholic drinks; eat less than usual and more simply; walk on the shady side of the street; avoid overexertion; let the air circulate freely about the head, either by frequent removal of the hat or by wearing a perforated head covering.

Insolation is more far-reaching and dangerous in its effects than most people know of; therefore a doctor should be called at once to any one with the symptoms above described as indicating heat stroke or true insolation.—Bulletin of Chicago Health Department.

RECHARGING DRY BATTERIES WITH GENERATOR

Having heard that dry batteries could be recharged by sending a current through them, in a direction opposite to that given



Recharging Dry Batteries

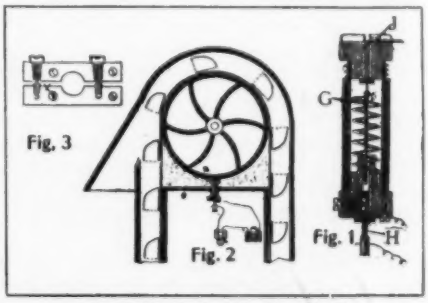
by the battery, we rigged up a small generator and gas engine, as shown in the sketch, and connected the batteries in series with the motor. After running a few minutes we stopped the engine and disconnected the batteries, which then gave a fairly strong current. Thinking to increase the charge, we connected the batteries exactly as they were the first time and started the engine in the same direction as before, and let the outfit run several hours. On returning we found the zincs all corroded and the batteries completely run down. Desiring to learn the cause of this seemingly peculiar behavior, we connected a new lot of batteries and proceeded as before. The engine was then stopped and the belt was removed from the generator, thus allowing the current of the batteries to run the generator as a motor. We expected the generator to run in a direction opposite to that used in charging, but were surprised to see it continue running in the same direction. The explanation is that the current from the batteries reversed the field, and also the armature, thus making two reverses which is the same as none at all. Then when the generator was run again by the engine the current was reversed because the poles of the field had been changed by the batteries.

We concluded from these experiments that in charging batteries in this way it is necessary to either change the connections on the battery, or reverse the rotation of the engine each time it is started. As the engine was two-cycle it was more easily reversed than the battery connections, and in this way, the batteries were recharged without any difficulty. A stronger charge may be given to batteries in which a quantity of water has been poured in holes drilled through the top.—Contributed by A. Davis, Chicago.

FIRE ALARM FOR GRAIN ELEVATORS

A choke in the elevator head which stops the belt while the head pulley keeps revolving is frequently the cause of fires in grain elevators, says the Grain Dealers' Journal. The pulley rubbing against the belt soon generates sufficient heat to start a blaze.

An alarm to warn the operator when the elevator head is becoming overheated has been devised. A round hole is bored in the middle of the strut board for the insertion of the device, which consists of a metal plug, shown in Fig. 1. The upper stopper of the plug fits loosely and rests against the pulley. The lower electrode, H, is firmly set while the upper electrode, G, is drawn up by a cord, J, held in place by wax. Overheating



Alarm for Grain Elevator Head

of the alarm melts the wax, releases the cord, permitting the coil spring to draw the upper electrode down into contact with the electrode, H. The closing of the circuit rings a bell placed in any convenient location. Fig. 2 shows the head with alarm in place, and Fig. 3 a clamp for holding the device in position.

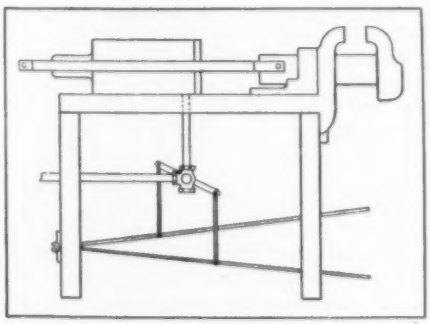
Frieze Design from the London Decorator

GREASE ERADICATOR FOR CLOTHING

Mix together 2 oz. oleate of ammonia and 2 oz. ammonia water; shake well and add 1 oz. ether and 5 oz. benzine. Shake well again and then add 1 oz. chloroform. Shake again, let stand a few minutes, then shake at frequent intervals until the preparation is of the consistency of cream.

AN AIR VISE

An old air brake cylinder, which had for years given good service to the S. P. Railroad, lay rusting on a scrap pile amid other discarded appliances, when, one day, C. C. Perry, of Houston, Tex., assistant foreman of the shop, conceived the idea of an air vise. He accordingly made the device shown in the sketch. An old vise, A, in which the screw had become nearly worn out, was connected to the air brake cylinder, B, in such a



Air Vise

way that the air entering the cylinder brought the jaws of the vise together. When the air was released the spring in the cylinder would open the jaws again.

The air in this arrangement is controlled by a 3-way cock, C, which is operated by the foot levers, D. A vise arranged in this way is not suitable for small work, as there is danger of injuring the hands, but for heavy work, which has to be changed frequently, it is a great labor-saver.

REMOVING MATCH MARKS FROM PAINT

To remove match marks from white paint, rub the spot with a cut lemon, says the Master Painter. Then to prevent a repetition of the offense apply a little vaseline and rub the spot dry with a rag. It will be difficult to strike matches there again.

POLISHES FOR BRASS

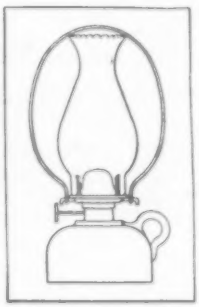
For cleaning hot brass cylinder heads and jackets, try the following recipe, which a correspondent of the Practical Engineer says works fine:

Sift coal ashes fine and mix with kerosene oil to a thick paste; add as much air-slaked lime as can be conveniently mixed with it. Apply this polish to the bright parts, rubbing hard; wipe off and polish with dry slaked lime.

Whiting and ammonia mixed to a paste is another good polish for brass. Apply and rub dry.

SAFETY CLASP FOR LAMP CHIMNEY

In carrying a hand lamp about the house, the chimney not infrequently falls off and is shattered. To prevent this, attach a wire loop to the lamp as illustrated, hinging the loop at the base of the chimney.—Contributed by T. L. Reed, La Porte City, Iowa.



SOME HINTS ON TEMPERING

One of the most essential conditions in properly hardening steel, is uniform cooling. An apparatus like that shown in Fig. 1, which was contrived by a correspondent of the Practical Machinist, will give good results for many kinds of work. The vertical inlet pipes have holes along the inner sides, which direct the stream of water to all parts of the piece to be hardened.

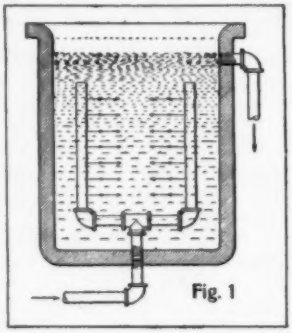


Fig. 1

In tempering a piece of steel like that shown at A, Fig. 2, it is not well to have the hardening stop at the shoulder, as there is then a great liability of cracking. Either harden beyond the shoulder, or if the smaller portion is sufficiently long, let the hardening stop short of the shoulder.

In tempering a tool such as is shown at B, Fig. 2, the best results will follow if the cutting end is not chilled until after the heavier, solid parts have contracted somewhat. If the lighter portions are chilled and contract before the heavier ones, the tendency is for the heavier parts, which are stronger than the lighter, to distort the lighter parts, making them conform to the shrinkage of the heavier, and as the steel is hard and rigid it must crack.

When hardening tools having holes it is advisable to fill the hole with fire clay in

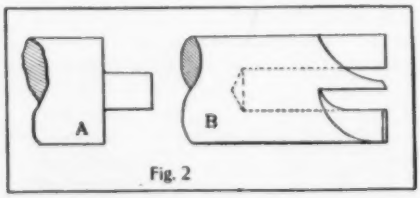


Fig. 2

order to prevent the water from entering. If the design is such that the tool is liable to crack when quenched, it should be dipped into the bath with the teeth uppermost, and the water should be warmed to reduce the liability to cracking.

Paste can be prevented from souring by adding a little pulverized bluestone.

SYSTEM OF NUMBERING FOR PARTY LINE TELEPHONE EXCHANGE

In rural districts where there are a great many party lines on the telephone exchange it is often difficult for the operator to quickly ring a certain party on a party line, because he must know the party's number and his ring also.

In an exchange with about 250 subscribers and 49 party lines, this difficulty was ingeniously overcome by a system of numbering. Take, for example, line 49: The first party on the line has one long and one short ring; his number is 491½; the next party has two rings, and his number is 492; the next has two long and one short ring and his number is 492½, etc. Suppose some one calls for No. 491½: All the operator has to do is to plug line 49 and give one long and one short ring. He has not a second's doubt, the number has told him exactly what to do. In this way an inexperienced operator can handle a party-line switchboard with ease.—Contributed by L. H. Meckstroth, New Knoxville, Ohio.

AN IMPROVED SOLDERING ACID

A very satisfactory soldering acid may be made by the use of the ordinary soldering acid for the base and introducing a certain proportion of chloride of tin and sal ammoniac. This gives an acid which is superior in every way to the old form. The method of making it is as follows.

To make one gallon of this soldering fluid take three quarts common muriatic acid and allow it to dissolve as much zinc as it will take up. This method, of course, is the usual one followed in the manufacture of ordinary soldering acid. The acid, as is well known, must be placed in an earthenware or glass vessel. The zinc may be sheet clippings or common plate spelter broken into small pieces. Place the acid in the vessel and add the zinc in small portions so as to prevent the whole from boiling over. When all the zinc has been added and the action has stopped it indicates that enough has been taken up. Care must be taken, however, to see that there is a little zinc left in the bottom, as otherwise the acid will be in excess. The idea is to have the acid take up as much zinc as it will.

After this has been done there will remain some residue in the form of a black precipitate. This is the lead which all zinc

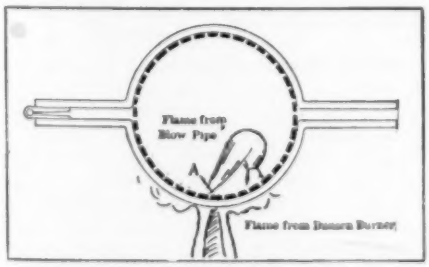
contains and which is not dissolved by the muriatic acid. This lead may be removed by filtering through a funnel in the bottom of which there is a little absorbent cotton, or the solution may be allowed to remain over night until the lead has settled and the clear solution can then be poured off. This lead precipitate is not particularly injurious to the soldering fluid, but it is better to get rid of it so that a good, clear solution may be obtained.

Now dissolve six ounces of sal-ammoniac in a pint of warm water. In another pint dissolve four ounces of chloride of tin. The chloride of tin solution will usually be cloudy, but this will not matter. Now mix the three solutions together. The solution will be slightly cloudy when the three have been mixed, and the addition of a few drops of muriatic acid will render it perfectly clear. Do not add any more acid than is necessary to do this, as the solution would then contain too much of this ingredient and the results would be injurious.

This soldering acid is used in the same manner as any solution of this kind, but it will be found that it will not spatter when the iron is applied to it. It has also been found that a poorer grade of solder may be used with it than with the usual soldering acid. From my experience I have found that a solder composed of two parts of lead and one of tin works equally as well and produces fully as strong a joint as that obtained with the customary half and half solder.—Charles H. Poland, in the Brass World.

METHOD OF BRAZING LIGHT WORK

A good method of brazing light work is illustrated. The dotted lines indicate the work—a light brass ring 2 in. in diameter, ½ in. wide and 1/22 in. thick. The ring is held together in the fixture made of ⅝ x ⅛-in flat iron. Place a bunsen burner under the fixture, which will keep the work and the fixture hot, but will not melt the brazing compound. Bring the flame from a blowpipe in contact with the joint at A.

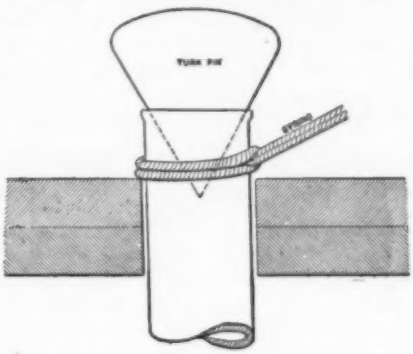


Brazing Light Work

This is a clean and handy method, says a correspondent of the American Machinist, and the brass has no tendency to adhere to the iron.

HOLDING A WASTE PIPE TO FLANGE IT

When there is no helper around to hold the bath waste or other waste pipe that must be flanged above the floor, try the following plan:



To Hold a Waste Pipe While Flanging It

Tie a piece of strong twine around the pipe and draw it up through the hole in the floor, holding it in place by means of the twine until the turn pin is inserted as illustrated, and the pipe is sufficiently expanded to prevent its dropping down again. The pipe can be flanged over entirely as desired, says the Metal Worker, after which cut off the string.

RAISING TEMPERATURE IN DRY KILNS

In a plant where the kilns used were of the moist air type and did not have coils enough to get a high temperature with exhaust steam, they were improved by a correspondent of the Engineers' Review as follows:

A fan was installed at one side of the kiln and the hot air was drawn from the top of the kiln at the cold end and forced back over the coils and up through the lumber again. This gave good circulation and resulted in drying the lumber much quicker.

The fan is driven from the line shafting

of the plant, and runs only 10 hours a day. At night live steam is supplied and the circulation is set up through the duct to the fan, but only in a slow current.

A vacuum pump placed on the end of the return from the kiln coils gives a more rapid circulation of the exhaust steam and relieves the engine of about 4 lb. back pressure. With this system a temperature of 160° is maintained.

THREADING STEEL PIPE

Most of the steam, gas and water pipe, which was formerly made of wrought iron, is now being made of mild steel. Steel pipe can be made cheaper and stronger than iron pipe and has the advantage of being more ductile and homogeneous. Mr. Frank N. Speller, of the National Tube Company, has prepared a paper touching upon these points, from which the following has been condensed:

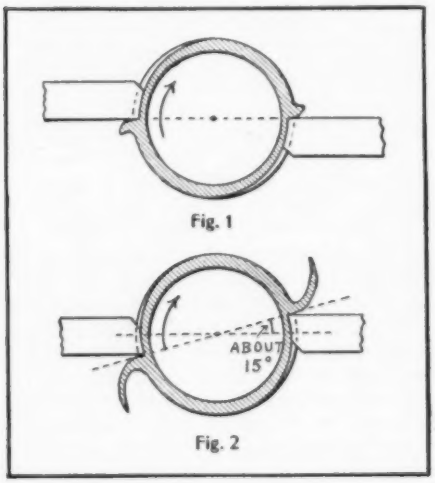


Fig. 1

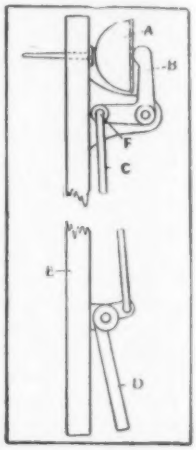
Fig. 2

Steel pipe is capable of receiving a smoother finish than iron, if the proper form of cutter is used. The old form of chaser (Fig. 1), in which the cutting edge is on the center, is not suitable for steel. Instead, the cutting edge should be advanced about 15°, as shown in Fig. 2. Many of the cutters in use at the present time are made like Fig. 1, which probably accounts for the slight prejudice against the new material. The use of the cutter shown in Fig. 2 will produce a better finish than can possibly be given to an iron pipe.

In recent tests of durability steel pipes corroded more than iron in salt water; in fresh water the corrosion was the same for each, and in acidulated water the iron pipes corroded the most.

AN OVERHEAD SHAFT OILER

The device here shown is very useful for oiling shafting and inaccessible machines. The oil can, A, is compressed by the bell crank, B, which is moved by the connecting rod, C, and the grip lever, D. The strip of wood, E, can be any desired length and should be drilled at the end to receive the oil can as shown. The connecting rod, C, can be made of either small iron rod or heavy wire and should be made to disconnect at F, thus allowing the removal of the oil can. The other parts can all be made of wood, but if desired the cranks and brackets may be made of metal, which would allow making them much smaller.

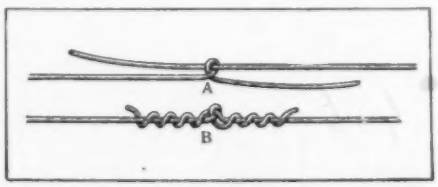


The Oiler

This device was patented about twenty years ago, but the patent has expired. It is practical, and very useful, as can be certified by a correspondent of the Wood-Worker who made several of these oilers.

TYING IRON WIRE

A method of tying iron wire which has been found an especially good joint for rural lines is shown in the illustration, from the American Telephone Journal.

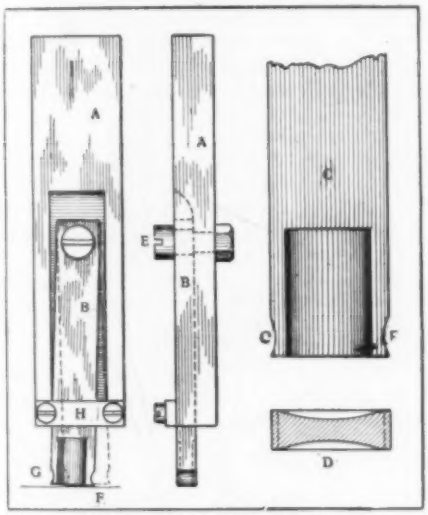


Tying Wire

Where there is danger that insecure joints may be made by inexperienced linemen, this method will be found especially satisfactory.

HOW TO MAKE A DOUBLE-CUTTING SLOTTING TOOL

Most of the tools used on planers and shapers take a cut while going in one direction, and then slide over the work on the return stroke, without accomplishing anything, but the tool shown in the sketch cuts in both directions. This tool consists of a holder, A, and a cutter, B, which is shown in detail at C and D. The cutter rests in a groove, cut in the holder, and swings from a bolt, E, which allows it to move about ¼ in., as indicated by the dotted lines. This raises the back edge, and gives the necessary clearance between the tool and the work. Each time the motion is reversed the cutter swings over to the opposite side,



Making a Double Slotting Tool

and raises the other edge, and thus takes a cut in both directions.

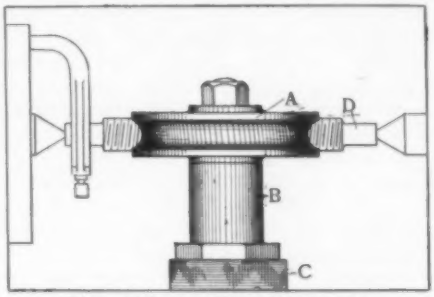
When the work requires a sharp cutting edge, the cutter should be ground away on the edges, as shown at F and G, and when used for slotting, the sides should be made concave, as shown at D. In order to prevent lateral movement of the cutter, a small piece of steel is screwed across the groove in the holder, as shown at H.

We have one of these tools in our shop and use it nearly every day and have yet to find one that will do better or quicker work.—Contributed by L. G. Harren, 14 Barnett St., New Haven, Conn.

Popular Mechanics' "Shop Notes for 1907" will be ready December 1, 1906.

HOW TO CUT WORM-WHEELS IN A LATHE

Some machinists will not attempt to make worm-wheels without the use of a milling machine, but a very good job can be done in a lathe, by making the simple attachment shown in the sketch. The blank

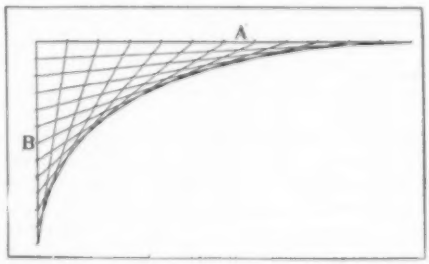


Worm Wheel Cutting Attachment

worm-wheel, A, which is to be cut, is fastened to an arbor, B, which is used in place of the tool post. The wheel is fastened in such a manner that it is free to revolve and a tap, D, is placed between the centers, and revolved by means of a dog. As the tap revolves the wheel is fed slowly against it, the pitch of the threads causing the wheel to revolve.—Contributed by Norman Baker, Hoopeston, Ill.

HOW TO LAY OUT AN APPROXIMATE ELLIPSE

An approximate ellipse can be drawn by the following method, which is used largely in laying out elliptical arches. Draw the



line A, equal to one-half the required length, and line B, equal to one-half the required width. Divide both lines into the same number of equal parts, and then connect the points of division as shown. This will form one quarter of the required ellipse. —Contributed by C. R. Gilkey, Sonora, Cal.

ACETYLENE AS A MOTIVE POWER FOR GAS ENGINES

By J. K. Rush, Canandaigua, N. Y.

The desirability of using acetylene for power purposes, and the great demand for a good acetylene engine for general purposes is conceded by all who have paid any attention to the rapid development of the acetylene industry in this and foreign countries within the last few years. Today acetylene is used on a large scale in all civilized countries, and in many instances where nothing else would fill the bill; it is used, not only to illuminate the homes of the well-to-do farmer and suburbanite, but even in some of the largest cities in this country it is used in competition with city gas and electricity, both for lighting homes and factories. It is not generally known that acetylene is now being extensively used for laboratory purposes where the very purest and most intense heat is desired, and it is very valuable for this purpose.

After enumerating only a few of the various places where acetylene is being used at the present time, both for illuminating and heating purposes, it can be readily seen what a wonderful field there is for the use of an acetylene engine. The farmer who lights his home, and uses acetylene to do all the cooking with an acetylene range (there are thousands in successful operation today), as well as using it for the instantaneous hot water heater in the bath room, which is heated with an acetylene heater, would much prefer to use an acetylene engine for pumping water and the various uses to which a gas engine is utilized on the farm today, than to be obliged to use some other method of accomplishing the work of a good gas engine, if it could be successfully done with acetylene manufactured on the premises, where one small machine will supply necessary gas for all of the above requirements.

Now we come to the question, "Is acetylene practical for power purposes?" In answer, it must be said that it is practical, but owing to the richness of the gas, which the analysis shows to be C_2H_2, it is not the easiest proposition in the world to figure out just how an acetylene engine should be constructed, and for that very reason, there are not as many successful acetylene engines in use as there would be if it were as easy to build an acetylene engine as one for coal gas or gasoline, but there are a few successful acetylene engines, nevertheless. It is only a few years ago that it was not possible to use acetylene for heating or cooking purposes, for the self-same reason that it is not used more in gas engines. The trouble with the use of acetylene for fuel purposes was that it is so rich in carbon that it was very difficult to mix it with the proper amount of oxygen to bring about proper combustion. But that trouble has been thoroughly overcome so far as the use of gas for fuel purposes is concerned, and today acetylene is successfully used in thousands of homes and laboratories for fuel and heating purposes.

One of the most important features of an engine to use acetylene successfully, is a perfect and very sensitive carbureter so arranged as to bring about a perfect mixture of gas and air. When this is done and all other conditions are complied with, acetylene works perfectly in an engine. Owing to the richness of the gas, a very small amount of acetylene is used and a much larger proportion of air than is the case with the use of coal gas. The writer is of the firm belief that if it were not for the fact that every manufacturer of a good gas or gasoline engine is having all he can do to fill orders for his regular line, that some of them, or more properly speaking, more of them would take an interest in the development of a good acetylene engine, and we would soon be able to get all of the acetylene engines we might desire, and have them for the various purposes for which they are so admirably adapted.

One reason why there has not been more done pertaining to the use of acetylene for engines is that only within the last three or four years have the generators been perfected to such an extent that it was possible to get acetylene of a standard quality and regular pressure. These difficulties have now all been overcome, and today there are at least six makes of generators manufactured in this country that can be depended upon to do all that their manufacturers claim for them, and are really high grade machines. But in this line as in all others there are a number of machines on the market that produce such a low grade of gas, and under such variable pressures that any mechanic who tried to do any experimenting with the use of acteylene for an engine would soon give up the job, when, as a matter of fact, it was the machine he was using that was at fault rather than the gas.

The same statement applies to acetylene

as to the use of steam, "You cannot get good results without good apparatus." You must have a good boiler and engine to get good results with the use of steam, and you must also have a good generator to get good results with the use of acetylene.

Mold on paper may be removed by applying with a soft hair brush a solution of 1 part salicylic acid in 4 parts grain alcohol.

TWO GOOD FORMS OF FILTERING CISTERN

To construct the cistern shown in Fig. 1, make the walls of stone, laid in hydraulic cement. For the bottom mix concrete, using 9 parts of gravel and sand to 1 of hydraulic lime, just moistened. Lay on in a mass to depth of 4 in. and pound hard. Let the lower course of flat stones of the wall (the footing) project 4 in. into the cistern to prevent cracks. Cover the top with two limestone flags, 6 in. thick, resting on the walls, with a manhole at one corner, and so cover and fit the whole with cement that insects or surface water cannot enter, except through the leader from the roof. Cover the manhole with a flagstone, cementing it at the edges, and surround it with a brick wall 1 ft. high, which cover with another flagstone, making air-tight with cement, thus leaving a foot of confined air and excluding frost. Cover the upper flagstone with a foot of earth, turf it, and then cover the whole cistern with earth.

For the filter, construct a vertical hollow cylinder, 2 ft. inside diameter, of good weather brick laid in hydraulic cement and extending from the concrete bottom to the top covering, with a 1-in. air-hole to allow the air to escape as the cylinder fills with water. This form of construction resists any sudden pressure of water against the exterior the same as an arch does. The water, after soaking through the 4 in. of brick, is well filtered.

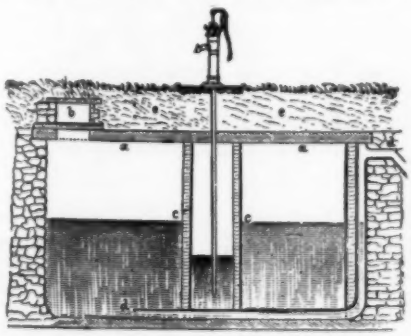


Fig. 1--Cistern for Filtering
a, a, Flags for Cover; b, Man-hole; c, c, Vertical Shaft for Filtering; d, d, Overflow; e, e, Earth.

Make the overflow from the cistern so as to give an escape for the filth coming from the roof and thus prevent necessity of frequent cleaning. Let the leader from the roof enter at one end and the waste pass from the other. Make a channel of 5-in. tiles across the bottom, beginning about 3 ft. from where the entering water strikes the bottom and thence by a brick flue, 4 by 6 in., against the side, to the overflow channel at the top, which should have a sharp descent through tiles, terminating in a 4-in. galvanized pipe with a self-acting valve at the bottom to be closed when no water is running. Cement well the whole channel inside the cistern.

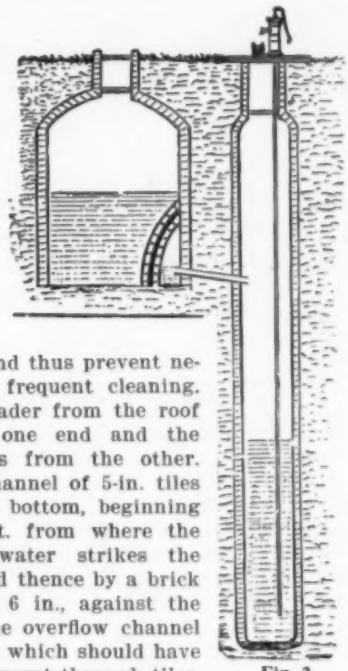


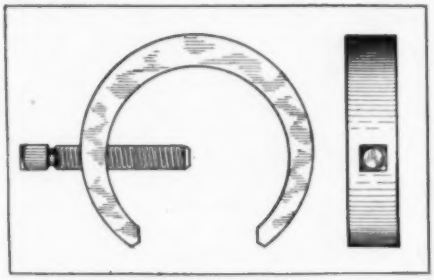
Fig. 2

In Fig. 2 the cistern for holding the filtered water is 24 ft. deep. Arch it with brick over the top, starting the arch 6 ft. below the surface. Make the cistern that receives the water from the roof 7 ft. deep, placing it at the side of the deeper one, and connecting the two with a pipe-tile. Make the filter of two walls of brick on edge, enclosing 2 in. of charcoal, the whole in a curve, with about 10 sq. ft. of surface, the water to pass freely through the brick. The washings from the roof and all warm rains are turned off and no waste pipe is required, says the Country Gentleman. Use a chain pump which will keep the water stirred. Bricks are used only for the arch at the top and the cement is plastered on the smooth surface of the earth.

A QUICK REPAIR FOR LEAKY PIPE

Factories, stores and other buildings, containing valuable stock, which is easily damaged by water, should be equipped with some means for stopping leaks in steam pipes, such as pinholes, as soon as discovered; otherwise the steam and rusty water coming from the pipe may cause expensive loss of property.

By having a number of clamps on hand, as shown in the sketch, a temporary repair



Repairing a Leaky Pipe

can be made almost instantly. These clamps can be made to take three or four different sizes of pipe, and are used in connection with small sheet steel plates and rubber gaskets. The steel plates and rubber gaskets should be about 1 in. square and about $\frac{1}{16}$-in. or $\frac{1}{8}$-in. thick. To stop a leak place the rubber on the hole; lay the piece of steel on the rubber, and apply the clamp, screwing same up tight, and having the center of the screw over the hole in the pipe. The steel pieces should be bent concave to fit the pipe, thus making a tight joint.

If desired the clamp may be left on the pipe permanently. I have two of these clamps in use which were put on over two years ago.—Contributed by O. C. Pottorff, 1310 N. 6th St., Springfield, Ill.

EXPERIMENTAL TELEPHONE LINE

In a recent issue of your magazine I noticed an article on how to make an experimental telephone, using the earth for a battery. A few days ago I built a similar line using carbon and zinc instead of water pipe for the ground and I now have a line running over to our neighbors with the very best results.

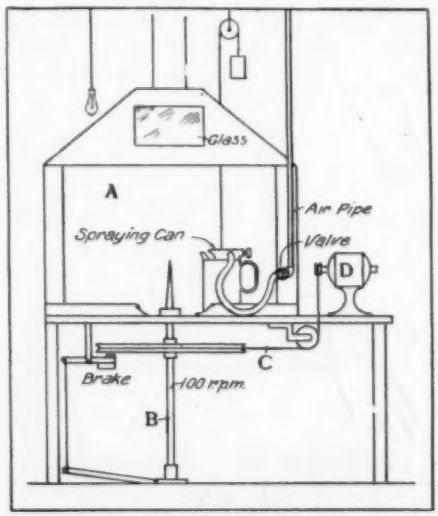
I noticed that about five o'clock p. m. each day a peculiar humming noise could be heard on placing the receiver to the ear, and later I discovered that the noise was caused by induction from the electric wires which pass over my lines about 2 or 3 ft. above them. On experimenting with it further I found that by cutting out the ground at one end (I have a metallic circuit to use in case the other should fail) and connecting it so as to have a metallic circuit, the induction formed from the electric light lines would transmit the sounds just as well as the other.

I have a disc record phonograph which I play over the line every evening. I take the horn off and hang the receiver on a hook which holds it up against the mouth of the leather elbow. On connecting it up (with the ground circuit or metallic) the music is plainly heard at the other end.—Contributed by Stewart H. Leland, Lexington, Ill.

COMPRESSED AIR JAPANNING MACHINE

The machine about to be described is one which could probably be used to advantage in all factories where japanning is done, as by its use twice as much work can be turned out and many articles can be given a much more even coat than is possible by the dipping process, or by hand work. It is especially useful for round or cylindrical work, but can be used for japanning any article that is not too large.

A wooden hood, A (see sketch), is left



Japanning Machine

open at the front, and is provided with a pipe at the top to carry away the fumes. Four glass windows are made in the top, and one or more electric lights are arranged so

as to illuminate the work. A vertical shaft, B, is revolved by means of a cord, C, which runs to an electric motor, D. The shaft is pointed at the top to receive a flat piece of wood for holding the work, nails being driven in the wood to accomplish this purpose.

As the work revolves it is given a coat of japan, by means of the spraying can, which contains the japan and is connected to an air hose, as shown. These cans can be purchased ready to use, and are provided with a special compressed air nozzle, which atomizes the japan and deposits it on the work. The japan used for this purpose should be thinned with turpentine before using, as it would otherwise make an uneven coat.

The machine should never run more than 100 r. p. m., and unless the work is very small 80 r. p. m. would be better. If it is run too fast the japan will be thrown off the work by centrifugal force. About 30 lb. air pressure is sufficient, but a greater pressure may be used by throttling down with the valve.—Contributed by W. J. S., Emsworth, Pa.

HOW TO MAKE A SMALL TAP-WRENCH

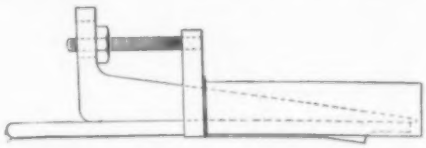
A small tap-wrench may be made of two pieces of pipe, a T fitting and two bolts. On one end of a piece of ⅜-in. pipe, A, cut a standard thread and file a $\frac{7}{16}$-in. machine bolt, B, to fit it snugly. Then file the head of the bolt to go inside the ⅜-in. T, indicated by D. File a groove, C, in the top of the head. Screw this pipe into the T tightly.

On a similar piece of ⅜-in. pipe, E, cut a long, loosely-fitting thread and stick a ⅜-in. bolt, F, into the end. This bolt should fit loosely, so it will remain stationary while the handle is being turned to tighten the wrench. Cut a groove, G, in this bolt, also. The tap is inserted in the third opening of the T and is held firmly when the loose handle is screwed up.—Contributed by Homer Keesling, Eden Vale, Cal.

HAND-CUT KEYWAYS IN PULLEY HUBS

The following method of cutting keyways in pulley hubs by hand was resorted to by a correspondent of the American Machinist who had a job that could not be done on a slotter.

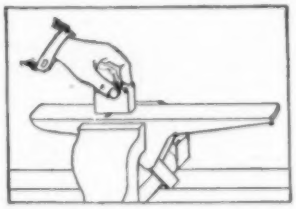
A piece with a flange at one end was forged and turned to size; the slot was then

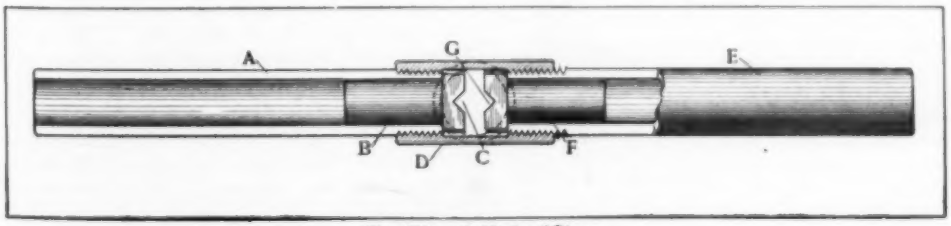


planed at an angle or taper and a wedge piece was made with a gib head having in it a slot through which passed a stud, the other end of which was tapped into the flange on the first piece mentioned. The stud was provided with a nut which held the gib wedge in place, while the drift or broach was driven through. The taper of the wedge was made to suit the taper wanted in the key seat. By turning the nut on the stud at each cut made, the feed was obtained.

A PATTERNMAKER'S KINK

Patternmakers and other wood workers know how difficult it is to plane a small block of wood without rounding the edges. A good way to avoid this trouble is to fasten the plane in the vice instead of the wood. The plane should be fastened in an inverted position, and the work can then be rubbed on the surface as shown. In this way a





Tap-Wrench Made of Pipe

good true surface to the exact dimensions may be obtained, as the work is always visible and the corners are not rounded in doing so.

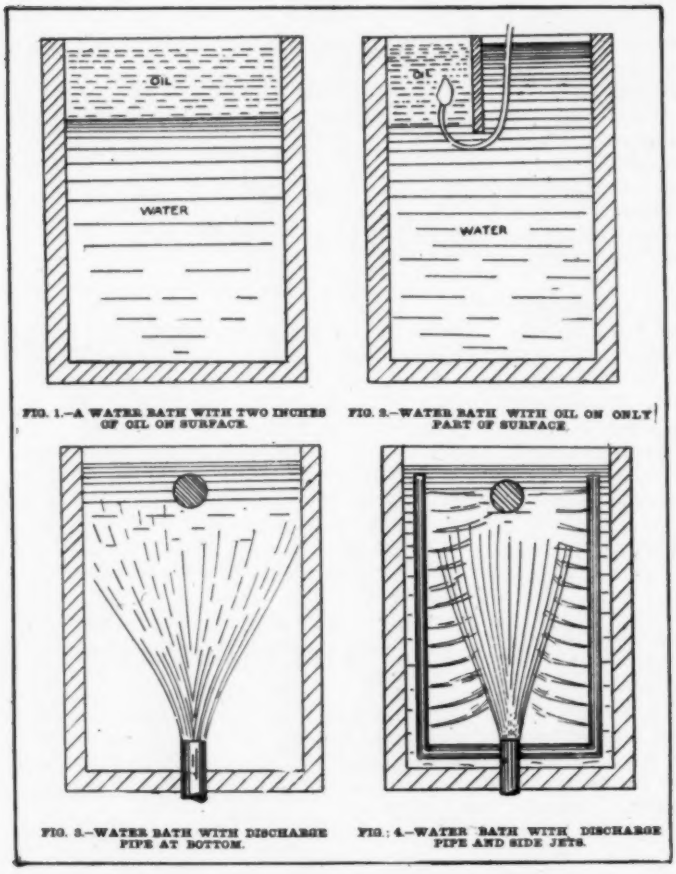


FIG. 1.—A WATER BATH WITH TWO INCHES OF OIL ON SURFACE.

FIG. 2.—WATER BATH WITH OIL ON ONLY PART OF SURFACE.

FIG. 3.—WATER BATH WITH DISCHARGE PIPE AT BOTTOM.

FIG. 4.—WATER BATH WITH DISCHARGE PIPE AND SIDE JETS.

THE SMALLEST BOOK

The smallest book in the British Museum and probably the smallest in the world is "The English Bijou Almanack for 1839." The book is printed in very clear type, but so small that the naked eye can hardly read it. It is illustrated, too, though, as will be observed, the little volume is scarcely larger than a man's thumb nail. It is kept in a small box with a glass lid.

KINKS FOR TEMPERING

When steel is heated red hot and then plunged into water, the rapid contraction sometimes causes it to crack. This is especially true of articles having small projections, or parts of different thicknesses. To avoid this difficulty a correspondent of the American Blacksmith recommends the use of a quantity of oil on the surface of the water, as shown in Fig. 1. This being a poorer conductor of heat than the water, does not chill the steel so suddenly, and prepares it for the water or brine below.

It is sometimes desirable to harden only the surface of a piece of steel and leave the interior tough. To do this a bath is constructed, with a partition extending below the surface of the water or brine, as shown in Fig. 2. This compartment is filled with oil, and the object to be hardened is fastened to a piece of iron, bent in the form of the letter J, as shown. The steel may then be passed from the water to the oil without exposing it to the air. Linseed oil is generally used for this purpose, although lard oil and sperm oil are sometimes substituted.

The baths shown in Figs. 3 and 4 are the ones generally used when it is desired to keep the contents agitated. This is very necessary for large work, as the hot steel forms steam, which collects in some places and leaves other portions exposed to the brine. This results in uneven cooling, which should always be avoided, as it leaves the steel softer in some places, and often cracks the work.

To free lampblack of grease, says the Master Painter, saturate it with alcohol and then set fire to it. The pure carbon, only, will remain.

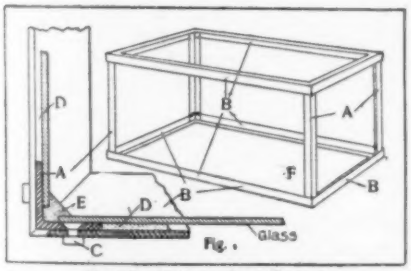
MECHANICS FOR YOUNG AMERICA

HOW TO MAKE AN AQUARIUM

In making an aquarium, the first thing to decide on is the size. It is well not to attempt building a very large one, as the difficulties increase with the size. An aquarium about 12 in. by 12 in. by 20 in. is a very good size and is inexpensive to build.

First buy one length of ¾-in. by ⅛-in. angle iron for the frame, F, Fig. 1. This can be obtained at any steel shop and should cost about 20 cents. All the horizontal pieces, B, should be beveled 45° at the ends and drilled for $\frac{3}{16}$-in. stove bolts. The beveling may be done by roughing out with a hacksaw and finishing with a file. After all the pieces are cut and beveled they should be drilled at the ends for the $\frac{3}{16}$-in. stove bolts, C. Drill all the horizontal pieces, B, first and then mark the holes on the upright pieces, A, through the holes already drilled, thus making all the holes coincide. Mark the ends of each piece with a figure or letter, so that when they are assembled, the same ends will come together again. The upright pieces, A, should be countersunk as shown in the detail, and then the frame is ready to assemble.

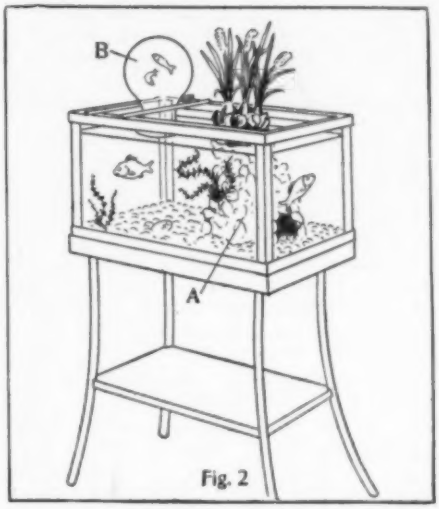
After the frame has been assembled take



Details of Aquarium Frame

it to a glazier and have a bottom made of sky-light glass, and sides and ends of double thick window glass. The bottom glass should be a good fit, but the sides and ends should be made slightly shorter to allow the cement, E, to form a dovetail joint as shown. When the glass is put in the frame a space, D, will be found between the glass and the horizontal pieces, B, of the frame. If this were allowed to remain the pressure of the water would spring the glass and cause a leak at E, so it is filled up with plaster of paris.

The cement, E, is made as follows: Take 1 gill of plaster of paris, 1 gill of litharge, 1 gill of fine white sand, and 1-3 of a gill of finely powdered rosin. Mix well and add



Aquarium Finished

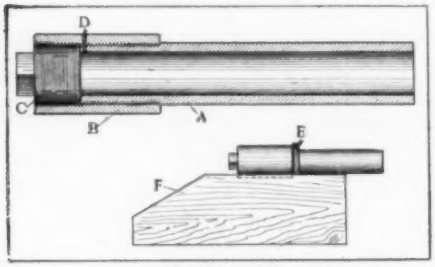
boiled linseed oil and turpentine until as thick as putty. Let the cement dry three or four days before putting any water in the aquarium.

In choosing stock for the aquarium it should be remembered that a sufficient quantity of vegetable life is required to furnish oxygen for the fish. In a well balanced aquarium the water requires renewal only two or three times a year. It is well to have an excess of plants and a number of snails as the snails will devour all the decaying vegetable matter which would otherwise poison the water and kill the fish.

If desired, a centerpiece (A, Fig. 2) can be made of colored stones held together by cement, and an inverted jar can be supported in the position shown at B. If the mouth of the jar is below the surface of the water it will stay filled and allow the fish to swim up inside as shown. Some washed pebbles or gravel should be placed on the bottom, and if desired, a few Chinese lilies or other plants may be placed on the centerpiece.

HOW TO MAKE A CANNON

A cannon, like the one in the cut, can be made from a piece of 1-in. hydraulic pipe, A, with a steel sleeve, B, and a long thread



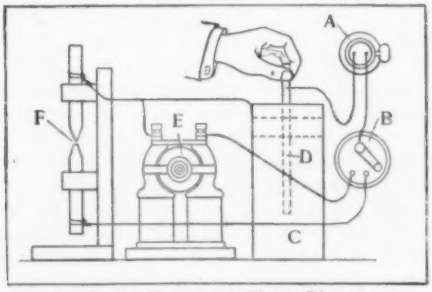
Toy Cannon

plug, C. Be sure to get hydraulic pipe, or double extra heavy, as it is sometimes called, as common gas pipe is entirely too light for this purpose. Don't have the pipe too long, or the cannon will not make as much noise. Seven or eight inches is about the right length for a 1-in. bore. Screw the plug and pipe up tightly and then drill a $\frac{1}{16}$-in. fuse hole at D.

If desired the cannon may be mounted on a block of wood, F, by means of a U-bolt or large staple, E.—Contributed by Carson Birkhead, Moorhead, Miss.

EASY EXPERIMENTS WITH ELECTRIC LIGHT CIRCUIT

An electric light circuit will be found much less expensive than batteries for performing electrical experiments. The sketch shows how a small arc light and motor can be connected to the light socket, A. The light is removed and a plug with wire connections is put in its place. One wire runs to the switch, B, and the other connects with the water rheostat, which is used for reducing the current.



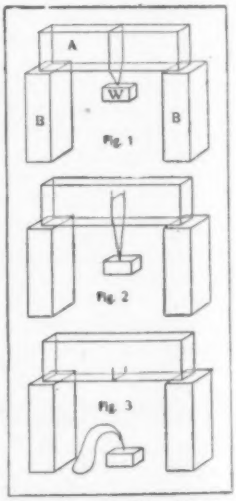
Arc Light Motor and Water Rheostat

A tin can, C, is filled nearly to the top with salt water and a metal rod, D, is passed through a piece of wood fastened at the top of the can. When the metal rod is lowered the current increases and as it is withdrawn the current grows weaker. In this way the desired amount of current can be obtained.

By connecting the motor, E, and the arc light, F, as shown, either one may be operated by turning switch B to the corresponding point. The arc light can be easily made by fastening two electric-light carbons in a wooden frame like that shown. To start the light, turn the current on strong and bring the points of the carbons together; then separate slightly by twisting the upper carbon and at the same time drawing it through the hole.

PECULIAR PROPERTIES OF ICE

Of all the boys who make snowballs probably few know what occurs during the process. Under ordinary conditions water turns to ice when the temperature falls to 32°, but when in motion, or under pressure, much lower temperatures are required to make it a solid. In the same way, ice which is somewhat below the freezing point can be made liquid by applying pressure, and will remain liquid until the pressure is removed, when it will again return to its original state. Snow being simply finely divided ice, becomes liquid in places when compressed by the hands, and when the pressure is removed the liquid portions solidify and unite all the particles in one mass. In extremely cold weather it is almost impossible to make a snowball, because a greater amount of pressure is then required to make the snow liquid.



Experiment with a Block of Ice

This process of melting and freezing under different pressures and a constant temperature can be better illustrated by the experiment shown in Figs. 1, 2 and 3. A block of ice, A, Fig. 1, is supported at each

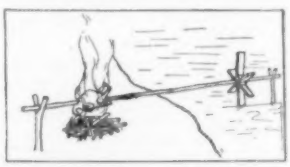
end by boxes BB, and a weight, W, is hung on a wire loop which passes around the ice as shown. The pressure of the wire will then melt the ice and allow the wire to sink down through the ice as shown in Fig. 2. The wire will continue to cut its way through the ice until it passes all the way through the piece, as shown in Fig. 3. This experiment not only illustrates how ice melts under pressure, but also how it solidifies when the pressure is removed, for the block will still be left in one piece after the wire has passed through.

Another peculiar property of ice is its tendency to flow. It may seem strange that ice should flow like water, but the glaciers of Switzerland and other countries are literally rivers of ice. The snow which accumulates on the mountains in vast quantities is turned to ice as a result of the enormous pressure caused by its own weight, and flows through the natural channels it has made in the rock until it reaches the valley below. In flowing through these channels it frequently passes around bends, and when two branches come together the bodies of ice unite the same as water would under the same conditions. The rate of flow is often very slow; sometimes only one or two feet a day, but no matter how slow the motion may be the large body of ice has to bend in moving.

This property of ice is hard to illustrate with the substance itself, but may be clearly shown by sealing-wax, which resembles ice in this respect. Any attempt to bend a piece of cold sealing-wax with the hands results in breaking it, but by placing it between books as shown in Fig. 4 or supporting it in some similar way it will gradually change from the original shape A, and assume the shape shown at B.

SPIT TURNED BY WATER POWER

Many of the Bulgarian peasants do their cooking in the open air over bonfires. The American Artisan describes a labor-saving machine in use which enables the cook to



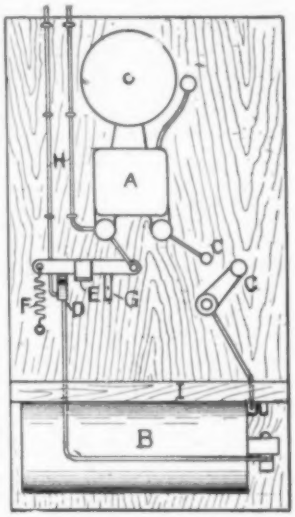
For a Summer Camp

go away and leave meat roasting for an hour at a time. The illustration shows how the spit to which the meat is fastened is constantly turned by means of a slowly moving water wheel. Some of our readers may wish to try the scheme when camping out. The success depends upon a slow current, for a fast turning wheel will burn the meat.

COMBINED DOOR BELL AND ELECTRIC ALARM

This device consists of a battery and bell connection to an alarm clock and also acts as a door bell, the whole being mounted on a board 18 in. long and 12 in. wide.

Referring to the sketch, the letters indicate as follows: A, bell; B, battery; C, switch; D, V-shaped copper strip; E, copper lever with 1-in. flange turned on one side; whole length, 4 in.; F, spring to throw lever, E, down in V-shaped piece to make connection; G, lever to hold out E when device is used as a door bell; dotted lines, H, go, one from bell, A, and one from battery, B, to the door; I, shelf for clock.



Door Bell and Alarm Combined

See that the ring in the alarm key of the clock works easily, so that when it is square across the clock it will drop down. Fasten a piece of copper about 1 in. long to key, then wind the alarm just enough so that the key stands straight up and down. Place the clock on the shelf and the key under the flange of lever, E. Pull lever, G, down out of the way and close the lever on the switch. The alarm key will turn and drop down, letting lever, E, drop into the V-shaped piece, D, and make connection.

For the door bell connection close lever on switch, C, and put G up so that D and E do not come in contact. If any one is ill and you do not want the bell to ring, open switch, C.

The wiring for this device may all be on

the back of the board. The switch and levers are fastened with small screw bolts, which allows wiring at the back. Saw two spools in half and fasten the halves to the four corners of the board at the back and the apparatus can be put up where one likes.

HOW TO MAKE A TELEGRAPH KEY AND SOUNDER

The sounder, Fig. 1, is made from an old electric bell magnet, D, fastened to a wooden base. The lever, A, can be made

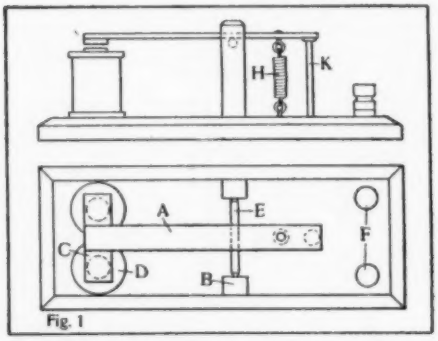


Fig. 1

SOUNDER—A, brass; B, wood; C, soft iron; DD, coils wound with No. 26 wire; E, nail soldered on A; FF, binding posts; H, spring.

of brass and the armature, C, is made of iron. The pivot, E, is made from a wire nail and is soldered to A. It should be filed to a point at each end so as to move freely in the bearings, B, which are pieces of hard wood.

The spring, H, is fastened at each end by pins, bent as shown, and should not be too strong or the magnet will be unable to move the armature. The stop, K, is a wire nail driven deep enough in the base to leave about ⅛ in. between the armature and the

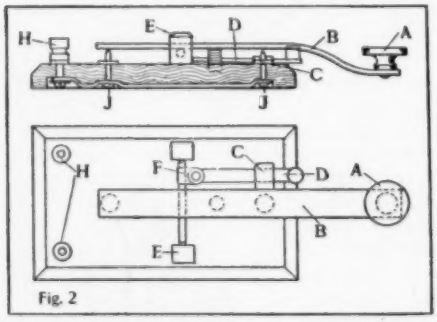


Fig. 2

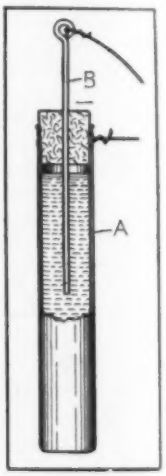
KEY—A, wood; B, brass or iron soldered to nail; C, brass; D, brass; E, wood; F, connection of D to nail; HH, binding posts.

magnet. The binding posts, F, can be taken from old dry batteries and are connected to the two wires from the magnet by wires run in grooves cut in the base.

The base of the key, Fig. 2, is also made of wood and has two wooden bearings, E, which are made to receive a pivot, similar to the one used in the sounder. The lever of the key is made of brass and has a hardwood knob, A, fastened near the end. A switch, D, connects with the pivot at F and can be either made from sheet brass, or taken from a small one-point switch. The binding posts are like those of the sounder, and are connected to the contacts, K, by wires run in grooves cut in the wood.

HOW TO MAKE A WATER RHEOSTAT

A water rheostat may be made by fitting a brass tube with a cork, through which a piece of wire is passed. The brass tube may be an old bicycle hand pump, A (see sketch), filled with water. Pushing the wire, B, down into the water increases the surface in contact, and thus decreases the resistance. An apparatus of this kind is suitable for regulating the current from an induction coil, when the coil is not provided with a regulator, and by using a piece of pipe instead of the tube, it can be used to regulate the speed of a motor.



For Regulating Current of Induction Coil or Speed of Motor

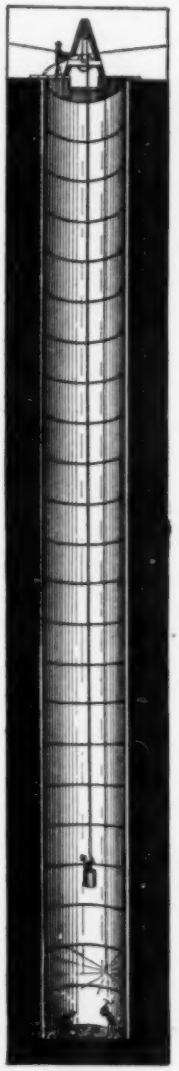
When the pipe is used, a piece of brass or copper rod should be substituted for the wire, in order to increase the surface. Adding salt to the water will decrease the resistance, and, when used with a motor, will give a greater speed.—Contributed by John Koehler, Ridgewood, N. J.

To prevent water colors from crawling, says the Master Painter, add a few drops of ammonia or lime water, or a solution of sal soda.

MODERN CONCRETE FOUNDATIONS

Enormous Wells Over 100 Feet Deep Filled with Concrete--Will Last for Ages

Cement has revolutionized foundation building. The old method, followed for many years, where a big structure was to be erected on soft ground, was to drive piles down to hard pan or rock. This was not only expensive, as the piles had to be driven close together, but a slow process, as too rapid driving smashed the pile. In laying the foundation for the new Chicago postoffice an entire year was spent in driving thousands of piles. Night and day the drivers pounded away, the noise being heard for blocks around.



The next method for foundations for skyscrapers was to excavate 10 or 15 ft. below the basement floor and with concrete and immense I-beams of steel make a great artificial rock covering the entire area to be occupied by the building. Big anchor bolts were imbedded in the mass, and to these the steel structure was fastened.

The latest system is to sink great wells or caissons to bed rock, and fill them with concrete, thus producing solid pillars of stone of great size and enormous strength.

Frequently these foundation pillars are completed before the old building is vacated, the structure being supported on jackscrews. In sinking the wells, for a large number are under way at the same time, an intricate system of endless cables, sheaves and pulleys are employed, driven by a steam engine. In Chicago the wells are carried down 100 ft. to reach the bed rock, and are from 6 ft. to 10 ft. in diameter. These when filled with concrete form foundations which will neither settle nor deteriorate with age, but on the contrary become harder with increasing years.

In making these caissons the dirt is elevated by a rope and bucket. The rope passes over a pulley and around an iron drum, which is kept revolving by one of the sheaves mentioned above. This drum, which is called the "nigger head," causes the bucket to ascend when the end of the rope is pulled, and allows it to lower when the end is held slack. A very slight pull will lift a heavy weight, as the rope is wrapped several times around the "nigger head," and for the same reason a heavy weight may be lowered with very little exertion on the part of the operator.

The buckets are not only useful for elevating the dirt, but are also used for raising and lowering the workmen, and when new material is required, for building the walls of the caisson, it is lowered in the same way. As fast as the well goes down the sides are protected with tongue and grooved lumber held in place by heavy iron bands. These bands are made in halves, so they may be lowered and are then joined when properly located.

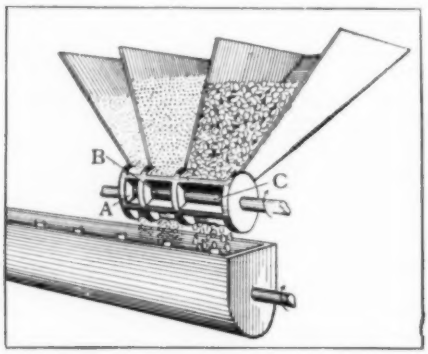
As would naturally be expected, the building of these caissons is a very dangerous occupation. Any carelessness on the part of the "nigger-head" operator, or any disorder of the cable, such as slipping off the sheave, usually leads to fatal results. It frequently happens that while the bucket is resting on the ground, at the bottom of the shaft, large lumps of clay adhere to the bottom of the buckets, and these while being elevated to the top of the caisson, often fall and strike the workmen below. The electric light at the bottom prevents the men from seeing the falling lumps, which often produce fatal injuries.

The dirt excavated from these caissons is disposed of in different ways. In the business districts of Chicago it is dumped into a chute, which leads to one of the many tunnels under the city, where it is then loaded into cars and hauled to the lake to be used for filling-in purposes.

After the caissons have been extended

down to solid bed-rock they are filled with concrete, which is fed through chutes leading to the bottom. There it is thoroughly tamped, as fast as deposited, until the top is reached, when it is ready to receive the steel structure of the new building.

The great quantities of material used in making these foundations has led to many new devices for automatically mixing the concrete. The latest invention of this kind, and one which has proved very satisfactory, is shown in the sketch. The usual proportions for concrete are 1 part cement; 3 parts sand, and 5 parts crushed stone, so the machine is made with revolving pockets, A, B, and C, which are 3 in., 9 in., and 15 in. wide, respectively, thus giving the correct proportions of 1, 3 and 5. These pockets are fed by hoppers which are kept filled with the materials, as indicated in the sketch. The materials drop from the pockets into a helical paddle conveyer, where the ingredients are thoroughly mixed and sprayed with water, after which the mixture is discharged into an elevator, which throws it into another hopper ready to be used.



New Concrete Mixer

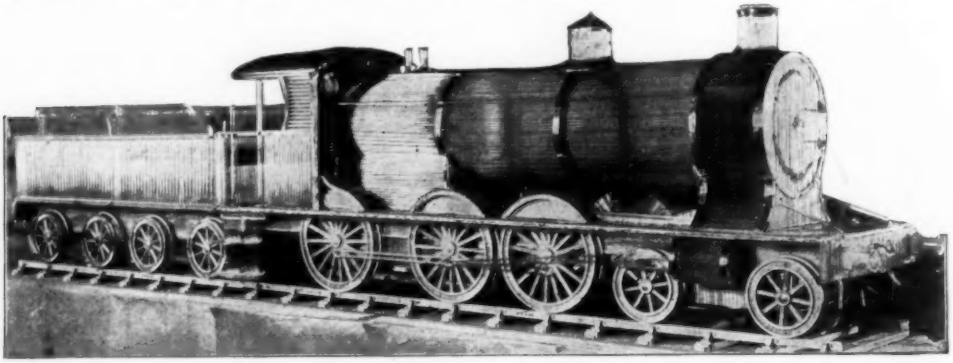
The revolving pockets may be replaced with others of different sizes in case different proportions are required, but the 1, 3 and 5 mixture is the one generally used. The partitions of the hopper are also adjustable, so that they may be made to correspond with different sized pockets. A small counting device attached to the machine enables the contractor to tell the exact amount of concrete that has been made. In a recent trial of this machine, the amount of cement used was only two sacks over the amount estimated, for a large job.

FIRING TORPEDOES BY WIRELESS

An apparatus for firing torpedoes by wireless electric power has been invented by a Frenchman. The machine, it is claimed, can be used in water or under ground and will receive the electric waves and transmit them to the mechanism of the torpedo though their source be miles away. No mast is used with this machine, as in some of the earlier attempts in the wireless transmission of power to mechanical objects. The firing device is cube-shaped, weighs about 7 lbs. and can be manufactured at a cost of $10.

REMARKABLE GLASS LOCOMOTIVE

One of the most remarkable models in the world is that of a standard locomotive, belonging to the Highland Railway of Scotland. The model is 15 ft. in length, 4 ft. high, and 3 ft. wide. All the parts are in exact proportion. Over 14,000 pieces of glass tubing were used, varying from 5 ft. to ¾ in. in length, and from 2½ in. to $\frac{1}{16}$ in. diameter. With the exception of the lagging bands, dome cover, and cap to stack, which are metal, the model is made entirely of glass.



Contains 14,000 Pieces of Glass

SEPTEMBER, 1906

POPULAR MECHANICS

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THE STORY OF KORNIT

Shares in the Kornit Manufacturing Company will advance from ten to twelve dollars each on September first.

BIG PROFITS MAKE BIG ...DIVIDENDS...

The Kornit Manufacturing Company is receiving letters and calls by almost every mail from different manufacturers who wish to buy KORNIT to use in their business. One rubber manufacturer in Newark, where our factory is situated, told Mr. Emanuel, our factory manager, the other day, that he was just as anxious as we were to have the time come when we could sell him all the KORNIT he needed, for it would save him many thousands of dollars every year by using KORNIT instead of hard rubber. This is the reason we are advancing the price of shares from ten to twelve dollars on Sept. 1. I feel assured that we will have a market for KORNIT just as fast as we can produce it. Here is indeed what I consider one of the best opportunities to make an investment, which will pay enormous dividends, that will ever be presented to you. Buy now while you can at the present price.

A FINANCIAL OPPORTUNITY

By President CHARLES E. ELLIS

KORNIT was invented by JOHANN GUSTAV BIERICH, a subject of the Czar of Russia, residing at Menkenhof, near Lievenhof, Russia, and is a Homogeneous Horn or Hoof substance. Kornit is produced by grinding horn and hoof shavings and waste into a palpable powder and then pressing under heavy hydraulic pressure with heat into a homogeneous slab. This slab produces a substance which can be sawed or turned, the same as ordinary wood. It is of a beautiful black consistency and IS EXTREMELY VALUABLE as a NON-CONDUCTOR FOR ELECTRICAL SUPPLIES. It is a matter of record that the electrical industry in this country AT THIS TIME DOES NOT HAVE a satisfactory material for heavy or high insulating purposes. A slab of Kornit one inch thick was tested in Trenton, New Jersey, by the Imperial Porcelain Works and was FOUND TO HAVE RESISTED 96,000 VOLTS OF ELECTRICITY. It may be interesting to note here that the heaviest voltage which is transmitted in this country is between Niagara, Buffalo and Lockport, New York. The voltage transmitted by this company is between 40,000 and 50,000 volts. Kornit is equally as good as a non-conductor for electrical purposes and supplies as is hard rubber.

The average price of hard vulcanized rubber for electrical purposes is today considerably over one dollar per pound—at the present writing something like $1.25 per pound.

KORNIT CAN BE SOLD AT TWENTY-FIVE CENTS PER POUND, and AN ENORMOUS profit can be made at this price, so that it CAN EASILY BE SEEN that where Kornit is EQUALLY AS GOOD, and AS A MATTER OF FACT, in many instances, a BETTER non-conductor than hard rubber, it can compete in every case where it can be used, with great success on account of its price. For electrical panel boards, switchboards, fuse boxes, cutouts, etc., there are other materials used, such as vulcanized paper fibre, slate, marble, etc. A piece of vulcanized paper fibre, 3x4x1 inch, in lots of 1,000, brings 20 cents per piece. A piece of Kornit of the SAME DIMENSIONS could be sold with the ENORMOUS PROFIT OF OVER 100 PER CENT at ten cents. The absorptive qualities of Kornit render it such that IT IS FAR PREFERABLE to that of vul

nized fibre. It will not maintain a flame. Of all the materials which are now in the electrical market for supplies and insulators there is, as we have stated above, none that are satisfactory. Kornit will fill this place. Its tensile strength per square inch averages from 1,358 pounds to 1,811 pounds, which the reader can readily see is MORE THAN SATISFACTORY. This test was made by a well known electrical engineer, who is now acting in that capacity for the United States Government, with a Standard Riehle Bros. testing machine.

Waste horn and whole hoofs are being sold by the ton today principally only for fertilizing purposes. There is one town alone, Leominster, Mass., where they have an average of eight tons of horn shavings every day. The waste horn shavings are now only being sold for fertilizing material. These eight tons of horn shavings manufactured into Kornit and sold for electrical purposes would easily bring $3,000. At this price it would be selling for less than one-fifth of what hard rubber would cost, and about one-half of what other competitive materials would sell for, even though they would not be as satisfactory as Kornit.

MR. JOHANN GUSTAV BIERICH, THE INVENTOR OF KORNIT, IN HIS SUMMER GARDEN AT MENKENHOF, RUSSIA.

Kornit has been in use in Russia about four years. In Riga, Russia, which is the largest seaport town of Western Russia, the Electrical Unions there are using Kornit with the greatest satisfaction, finding it preferable to any other insulating material.

The expense of manufacturing Kornit from the horn shavings is not large, as the patentee, Mr. Bierich, has invented an economical and satisfactory process which produces an article that, in the near future, will be used in the construction of almost every building in this country.

Besides electrical insulators, Kornit can be used for the manufacturing of furniture, buttons, door handles, umbrella, cane, knife and fork handles, brush and sword handles, revolver handles, mirror backs, picture frames, toilet accessories, such as fancy glove boxes, jewel cases, glove stretchers, shoe lifts, etc.; office utensils, such as paper-knife and pen holders, ink stands, pen racks; medical instruments, such as syringes, ear trumpets, etc., etc.; pieces for games, such as draughts, chessmen, dominoes, checkers, counters, chips, cribbage boards, etc.; telephone ear pieces, stands, etc.; piano keys, typewriter keys, adding machine and cash register keys, tea trays, ash trays, scoops, mustard and other spoons, salad sets, cigar and cigarette cases, cigar and cigarette holders, match boxes, and hundreds of other useful and ornamental articles, all at a large and remunerative profit.

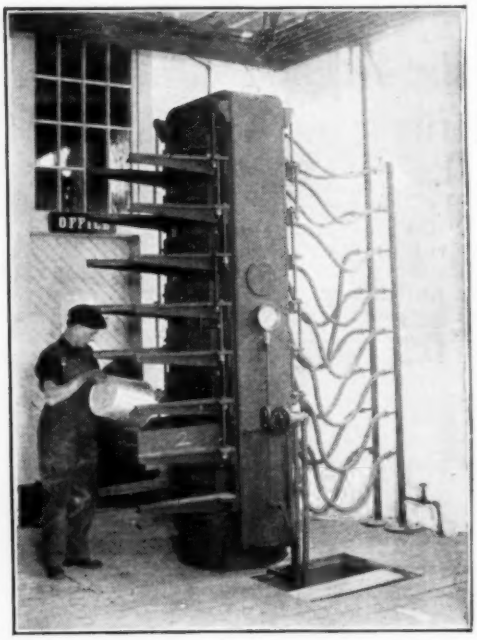
The Great Demand for Kornit in this Country

THERE is one manufacturer ALONE here in New York that uses 60,000 square feet of insulating material for panel boards every year. He is now using slate and marble, but IT IS NOT SATISFACTORY, for the reason that in boring and transportation IT BREAKS SO EASILY. KORNIT WILL ANSWER THE PURPOSE OF MANUFACTURING PANEL BOARDS VERY MUCH MORE SATISFACTORILY. On 60,000 square feet of Kornit there would be a net profit of over $30,000, or 50 cents for every square foot used. THIS ONE EXAMPLE is cited to show you THE ENORMOUS PROFITS which can be made. There are a great many other panel and switchboard manufacturers in this country. You may be interested to know that a panel board is a small switchboard. There is one or more on every floor of all large buildings where electricity is used. They each have a number of switches mounted on them, so that those in charge can turn certain lights on or off, and by these panel boards all the electrical power in the building is controlled. They must be of a reliable non-conducting material. Kornit can be used for this purpose almost exclusively. The largest electrical manufacturing concerns in Riga, Russia ARE USING KORNIT ONLY FOR THIS PURPOSE, after having tried all other so-called non-conducting compositions. The electrical trades alone can consume a great many tons of Kornit every day in the year. If only two tons of Kornit are manufactured and sold every working day in the year IT WILL ENABLE THE KORNIT MANUFACTURING COMPANY TO PAY 16 PER CENT DIVIDENDS EVERY YEAR. Of course, if four tons a day are sold the dividends will be 32 per cent per year. THIS IS NOT IMPROBABLE. AN EXPERT ELECTRICAL ENGINEER who holds one of the most responsible positions here in New York City made the statement, after thoroughly examining and testing

Kornit for electrical purposes, that in his most conservative estimation there can be ten tons of manufactured Kornit sold every working day in the first year. This would mean that the Kornit Manufacturing Company would pay a dividend out of its earnings the first year of over seventy-five per cent (75%). This is probably more than will be paid the first year, but there certainly seems to be a good prospect of paying a large dividend the first year.

THERE WILL BE SUCH AN ENORMOUS DEMAND FOR KORNIT THAT, FROM YEAR TO YEAR, THE DIVIDENDS EARNED WILL BECOME LARGER AND LARGER. THIS IS THE BEST OPPORTUNITY TO MAKE AN INVESTMENT THAT YOU HAVE EVER HAD.

It is a well known fact that THE MOST LEGITIMATE and PROFITABLE way to MAKE MONEY is by manufacturing some product that is "NECESSARY" and ONE THAT CAN BE FULLY CONTROLLED so that nobody else can manufacture the same article. Look at Sugar (which is protected by a high



ONE OF THE HEAVY HYDRAULIC PRESSES IN KORNIT FACTORY WITH PRESSURE OF 720 TONS.

tariff); at Standard Oil, the Telephone, the Telegraph, and we might go on and enumerate many more monopolies. THEY ARE THE BIG MONEY MAKERS OF TODAY. KORNIT CANNOT BE MANUFACTURED BY ANYBODY IN THIS COUNTRY EXCEPT OURSELVES OR OUR AGENTS. We own all the patents issued by the UNITED STATES GOVERNMENT to the inventor, MR. JOHANN GUSTAV BIERICH, IN RUSSIA. These patents HAVE BEEN BOUGHT from Mr. Bierich and ARE DULY TRANSFERRED TO THE KORNIT MANUFACTURING COMPANY and the same is DULY RECORDED IN THE PATENT OFFICE OF THE UNITED STATES.

We Have a Fine Factory Complete in Every Detail

WE have a fine factory in Newark, N. J. (BELLEVILLE STATION), in a most excellent location, handy to the cars and also to the shipping. Our Factory is entirely completed and we are manufacturing perfect Kornit slabs.

This is one of the important epochs in *my life*, and I firmly believe in the history of the manufacturing business in this country.

MR. KURT BIERICH, the son of the inventor, who is a graduate of FREIBURG UNIVERSITY, GERMANY, arrived here from Russia on the 12th of May, to take full charge of the scientific conduct-

If you will carefully cast over in your mind and pick out twenty of the wealthiest people you personally know you will find in each case that it is a fact that years ago each one of these persons, or their ancestors, learned how to make a little money do a whole lot of work, and that now they and their children reap the benefit in a golden harvest.

You can do the same. Only you must make a beginning. Here is a financial opportunity. Take advantage of it now—not tomorrow, but right now, today. You are making money. Why not invest a little and later on reap the benefit. It is the wise thing to do, and the wise and thoughtful people who are doing it are the ones that live in case.

ing of our factory. MR. KURT BIERICH spent two years in his father's factory at MENKENHOF, RUSSIA, and six months at the workshops in RIGA, RUSSIA, mastering every minute detail of the manufacturing and working departments. MR. BIERICH, JR., has been employed for six months recently in superintending the erection of a Kornit factory for the English company at Stoke Newington, N. London, WHICH HE BROUGHT TO COMPLETION IN THE MOST SATISFACTORY MANNER. MR. BIERICH, JR., will have full charge of the KORNIT FACTORY IN THIS COUNTRY. KORNIT WILL QUICKLY BECOME A WELL KNOWN AND UNIVERSALLY USED ARTICLE IN ELECTRICAL AND OTHER TRADES OF THIS COUNTRY, EARNING AND PAYING LARGE AND SATISFACTORY DIVIDENDS EACH AND EVERY SIX MONTHS. A few shares obtained at the present price may be the foundation of a fortune or the much desired income for support in the unknown years that are to come. We leave it to you if it would not seem good judgment to take immediate advantage of this opportunity. Anyway, please write me at once and let me know just what you will do. If it is not possible for you to take shares now, write and tell me how many you would like and how soon it will be convenient for you to do so, provided I will reserve them for you at the

present price. As soon as I receive your letter I will answer it with A PERSONAL LETTER AND WILL ARRANGE MATTERS AS YOU WISH TO THE BEST OF MY ABILITY.

REMEMBER, I HAVE A GREAT MANY THOUSAND DOLLARS INVESTED IN THE KORNIT MANUFACTURING COMPANY, and the minute you buy a share or more in this Company we become CO-PARTNERS as CO-SHAREHOLDERS. It is for our mutual benefit to watch and guard each other's interests. I WILL BE GRATEFUL IF YOU WILL WRITE ME TODAY, so that I may know just what you will do. I predict that after *Kornit* has been on the market for a year that the *further advance* in price of the shares will be fully equal to that which occurred in Bell Telephone shares.

I know you will agree with me that you have never had presented to your notice a better opportunity to make an investment where such large profits can be made, because of the exclusiveness of control, and the great demand and the low cost of raw material, which is now almost practically thrown away. Join me in this investment at the present price of shares and I assure you it is my sincere belief that in the future you will say: "That is the day I made the most successful move in my whole life."

SHARES. ONE HUNDRED DOLLARS WILL BUY TEN SHARES. ONE THOUSAND DOLLARS WILL BUY ONE HUNDRED SHARES, AND SO ON. *On and after September first the price of shares will advance to twelve dollars ($12.00) each.* After you have bought one or more shares in THE KORNIT MANUFACTURING COMPANY you may feel as I do, that you have placed your savings WHERE THEY WILL DRAW REGULAR and SATISFACTORY LARGE DIVIDENDS.

I SHOULD NOT BE A BIT SURPRISED if these shares paid dividends as high as one hundred per cent in the not far distant future. Consequently, a few dollars invested now in the shares of the KORNIT MANUFACTURING COMPANY at the present price of $10 each will enable you in the future to draw a REGULAR INCOME from the large profits of the Company as they are earned. THE DIVIDENDS will be paid semi-annually, every six months, the first of May and November of each

KORNIT FACTORY, NEWARK, N. J. (BELLEVILLE STATION)

My Offer to You Today

THE KORNIT MANUFACTURING COMPANY is incorporated under the laws of New Jersey and is capitalized with 50,000 FULLY PAID NON-ASSESSABLE shares at $10 each. TEN DOLLARS WILL BUY ONE SHARE. TWENTY DOLLARS WILL BUY TWO SHARES. FIFTY DOLLARS WILL BUY FIVE

year. THIS IS ONE OF THE BEST OPPORTUNITIES YOU WILL EVER HAVE PRESENTED TO YOU IN YOUR WHOLE LIFETIME. I HAVE INVESTED A GREAT MANY THOUSAND DOLLARS IN THE KORNIT MANUFACTURING COMPANY, AND I FEEL SURE IT IS ONE OF THE BEST INVESTMENTS I HAVE EVER MADE. I can TRUTHFULLY say to you that I FULLY BELIEVE that you will be more than pleased with your investment and that YOU WILL NEVER BE SORRY. REMEMBER, that you here have an opportunity to become interested in a large industrial manufacturing concern manufacturing a product, with an exclusive monopoly, which HAS NEVER BEFORE been manufactured or sold in this country.

Remember, that it is by no means an experiment AS IT HAS BEEN SUCCESSFULLY MANUFACTURED AND SOLD FOR OVER FOUR YEARS IN RUSSIA

AT A LARGE PROFIT, and the manufacturer and inventor recently wrote that the DEMAND IS INCREASING EVERY DAY, beyond the capacity of their manufacturing facilities.

Now is the time for you to take advantage of this magnificent opportunity to make an investment in these shares, before the price advances, which will be the first of next month. I EARNESTLY BELIEVE that in a few years THESE SHARES WILL BE WORTH FROM FIFTY DOLLARS TO ONE HUNDRED DOLLARS each, on account of THE LARGE DIVIDENDS which the company will earn and regularly pay each and every six months. It is a well known fact that ten dollar shares that pay fifty (50) to one hundred (100) per cent dividends will readily sell in the open market for $50 to $100. THE OUTLOOK FOR THE KORNIT MANUFACTURING COMPANY is such that it seems impossible for the earnings to fall far short of these figures. If the company only makes and sells two tons of Kornit a day for the first year, and made a profit of only $200 per ton, it would mean a profit of over sixteen per cent (16%) the first year. If this business were doubled the second year, of course the earning capacity would more than double, and the dividends would be over thirty-two per cent (32%). Prominent and well known electrical engineers assure me that this product cannot help and is bound to make enormous profits. I would recommend that you send for as many shares as you may wish at once. You, in my conservative opinion, can safely count on the large earning capacity of these shares. I will at once write you a personal letter with full information, and send you our illustrated book, "A Financial Opportunity," containing a score of photographs of the KORNIT industry, taken in Russia. All letters bearing postmark prior to September 1 will entitle writer to present price.

MR. KURT BIERICH, THE SON OF THE INVENTOR OF KORNIT WHO ARRIVED HERE DIRECT FROM RUSSIA MAY 12, AND WHO IS NOW DEVOTING HIS ENTIRE TIME AT THE KORNIT FACTORY AT NEWARK (BELLEVILLE STATION), N. J.

Please let me hear from you before the price advances to $12 per share.

Yours very truly,

CHARLES E. ELLIS

PRESIDENT

717B Temple Court, NEW YORK CITY

[Mr. Ellis, besides being President of this company, is also President of two other large and successful companies, owning shares therein valued conservatively at over $250,000. Mr. Ellis has other investments in New York City real estate, bonds, stocks and mortgages to the amount of many more hundreds of thousands of dollars. Any bank or mercantile agency will tell you his guarantee is as good as gold. THIS is a successful man who wishes you for a Co-partner, as a Shareholder and Dividend Receiver in this company. Remember you will do business personally with Mr. Ellis in this matter.]